DOCUMENT RESUME

ED 116 973 SE 020 268

AUTHOR Stoakes, K. C.; And Others
TITLE Plant Operations for Wastewater Facilities, Vol. II, Part D. An Instructor's Guide for Use of Instructional Material in Wastewater Technology Training Programs.
INSTITUTION Clemson Univ., S. C. Dept. of Environmental Systems Engineering.; Environmental Protection Agency, Washington, D.C. Municipal Permits and Operations Div.; Linn-Benton Community Coll., Albany, Oreg. Dept. of Environmental Technology.
PUB DATE Sep 75
NOTE 90p.; For related documents, see SE 020 265-269

EDRS PRICE MF-$0.76 HC-$4.43 Plus Postage
DESCRIPTORS Educational Objectives; Environmental Education; *Post Secondary Education; *Teaching Guides; Technical Education; *Technology; Vocational Education; *Waste Disposal; Wastes; *Water Pollution Control
IDENTIFIERS *Sewage Treatment

ABSTRACT

This instructor's guide, designed for use with the curriculum, Plant Operations for Wastewater Facilities, represents a two-year wastewater technology instructional program based on performance objectives designed to prepare undergraduate students to enter occupations in water and wastewater treatment plant operations and maintenance. This document, part D of five parts, covers the topics of Sludge Dewatering, Solids Disposal and Effluent Disposal. In this guide, the topics and ideas are presented as a series of modules, organized around 16 general objectives common to all processes. The module begins with a statement of purpose which explains what the student will be studying. Next, all the objectives of the module and code numbers keyed to a computerized list of instructional resources are listed. Also included in each module are a glossary of verbs and sections on learning and testing conditions, acceptable performance, instructor activity and student activity. Recommendations on evaluation techniques are included. (BT)

****
* Documents acquired by ERIC include many informal unpublished *
* materials not available from other sources. ERIC makes every effort *
* to obtain the best copy available. Nevertheless, items of marginal *
* reproducibility are often encountered and this affects the quality *
* of the microfiche and hardcopy reproductions ERIC makes available *
* via the ERIC Document Reproduction Service (EDRS). EDRS is not *
* responsible for the quality of the original document. Reproductions *
* supplied by EDRS are the best that can be made from the original. *
****

ED116973

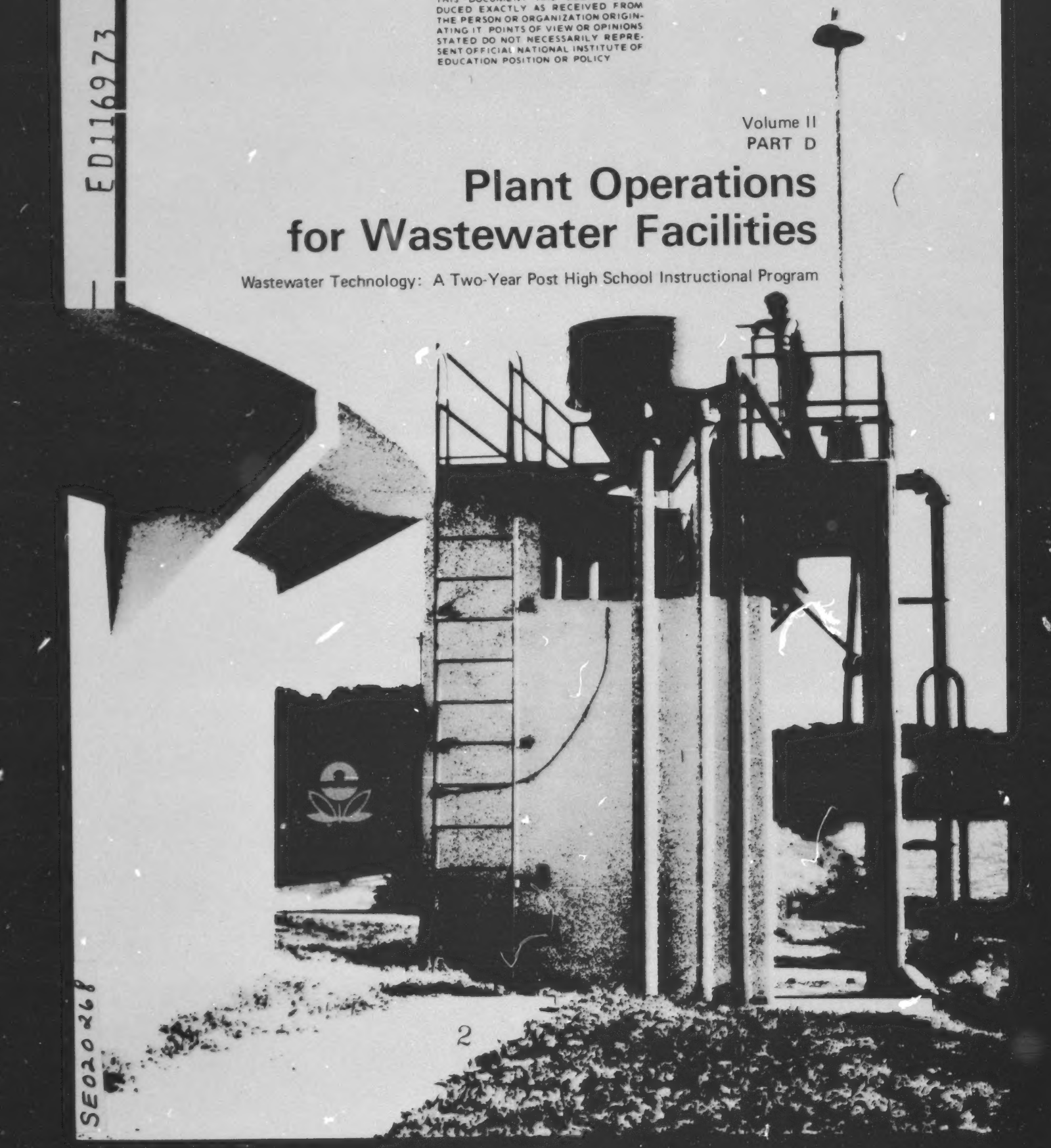
U.S. DEPARTMENT OF HEALTH,
EDUCATION & WELFARE
NATIONAL INSTITUTE OF
EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

Volume II
PART D

Plant Operations for Wastewater Facilities

Wastewater Technology: A Two-Year Post High School Instructional Program



SE020268

PLANT OPERATIONS FOR WASTEWATER FACILITIES, Part D

Sludge Dewatering
Solids Disposal
Effluent Disposal

An Instructor's Guide for Use of Instructional Material
In Wastewater Technology Training Programs

Funded by

US ENVIRONMENTAL PROTECTION AGENCY
Municipal Permits & Operations Division
Water Quality Control Manpower Training Branch
Academic Training Section

Awarded to

CHARLES COUNTY COMMUNITY COLLEGE
La Plata, Maryland

GREENVILLE TECHNICAL COLLEGE
Greenville, South Carolina

LINN-BENTON COMMUNITY COLLEGE
Albany, Oregon

ENVIRONMENTAL SYSTEMS ENGINEERING
Clemson University
Clemson, South Carolina

September 1975

For Information

ON FUNDING OF INSTRUCTIONAL PROGRAMS

Academic Training Section
Water Quality Control Manpower Training Branch
Municipal Permits & Operations Division
US Environmental Protection Agency
Washington, DC 20460
703-557-7335

ON PROJECT ADMINISTRATION AND CURRICULA DEVELOPMENT

John H. Austin, Professor and Head
Environmental Systems Engineering
Clemson University
Clemson, South Carolina 29631
803-656-3276

ON PROGRAM IMPLEMENTATION

Carl Schwing
Charles County Community College
La Plata, Maryland 20646
301-934-2251

James L. Chocklett
Greenville Technical College
Greenville, South Carolina 29606
803-242-3170

Peter C. Scott
Linn-Benton Community College
Albany, Oregon 97321
503-928-2361

Preface

Since 1970 Charles County Community College, Clemson University, Greenville Technical College and Linn-Benton Community College have been working together to prepare undergraduate students to enter occupations in water and wastewater treatment plant operations and maintenance. Through their efforts a two-year wastewater technology instructional program based on performance objectives has been developed and implemented.

Through a grant from the Environmental Protection Agency called *Criteria for the Establishment of Two-Year Post High School Wastewater Technology Programs (CEWT)* the four colleges set up program criteria and curriculum guidelines which are available in two volumes:

Program Implementation Procedures
Volume II: Curriculum Guidelines, Criteria for Establishment and Maintenance of Two-Year Post High School Wastewater Technology Programs

As a result of the implementation of the instructional program at Charles County Community College, Greenville Technical College and Linn-Benton Community College, six guides for instructors based on the course descriptions in *Plant Implementation Procedures* and the general criterion behaviors of *Volume II* have been prepared. *Plant Operations for Wastewater Facilities*, printed in five parts, is the second in the series which includes:

Volume I *Introduction to Environmental Technology*
Volume II *Plant Operations for Wastewater Facilities*
Volume III *Laboratory Control for Wastewater Facilities*
Volume IV *Management and Supervision Procedures for Wastewater Facilities*
Volume V *Process Interaction for Wastewater Facilities*
Volume VI *Advanced Waste Treatment*

ACKNOWLEDGEMENTS

Since the beginning of the project many persons at the four cooperating institutions, as well as outside consultants have participated in the development of this program. Their efforts which have provided source material for this guide have been acknowledged in the volumes to which they made major contributions. *Plant Operations for Wastewater Facilities* has been written and produced by:

Technical Staff

K. C. Stoakes, Instructor, Environmental Technology Department, Linn-Benton Community College

John F. Wooley, Instructor, Environmental Technology Department, Linn-Benton Community College
John W. Carnegie, Chairman of Environmental Technology, Linn-Benton Community College
Fred L. Delvecchio, Director of Operator Training, Environmental Systems Engineering, Clemson University
John R. Austin, Professor and Head, Environmental Systems Engineering, Clemson University

Editorial and Production Staff

Ada Louise Steirer, Freelance Editor, Clemson, South Carolina
Marie N. Sims, Project Secretary, Environmental Systems Engineering, Clemson University
Charlotte Holmes, Typing Services, Clemson, South Carolina
Jan Willis, Editorial Assistant, Environmental Systems Engineering, Clemson University
Eleanor McLasky, Typist, Environmental Systems Engineering, Clemson University
Roma Norton, Typist, Environmental Systems Engineering, Clemson University
Linda Flagg, Proofreader, Environmental Systems Engineering, Clemson University

Table of Contents

		Page
PREFACE		iii
PERFORMANCE OBJECTIVES		1
INTRODUCTION TO MODULES OF INSTRUCTION		3
GLOSSARY OF VERBS		9
MODULES OF INSTRUCTION		
Module 1	Collection	Part A
Module 2	Chlorination	Part A
Module 3	Screening and Grinding	Part A
Module 4	Grit Removal	Part A
Module 5	Primary Sedimentation	Part A
Module 6	Trickling Filtration	Part B
Module 7	Aeration	Part B
Module 8	Secondary Sedimentation	Part B
Module 9	Pond Stabilization	Part B
Module 10	Thickening	Part C
Module 11	First Stage Digestion	Part C
Module 12	Second Stage Digestion	Part C
Module 13	Sludge Conditioning	Part C
Module 14a	Sludge Dewatering	13
Module 14b	Sludge Dewatering	31
Module 15	Solids Disposal	49
Module 16	Effluent Disposal	67
Module 17	Flow Measurement	Part E
Module 18	Pumping and Piping	Part E
Module 19	Electric Power	Part E
Module 20	Gas Power	Part E

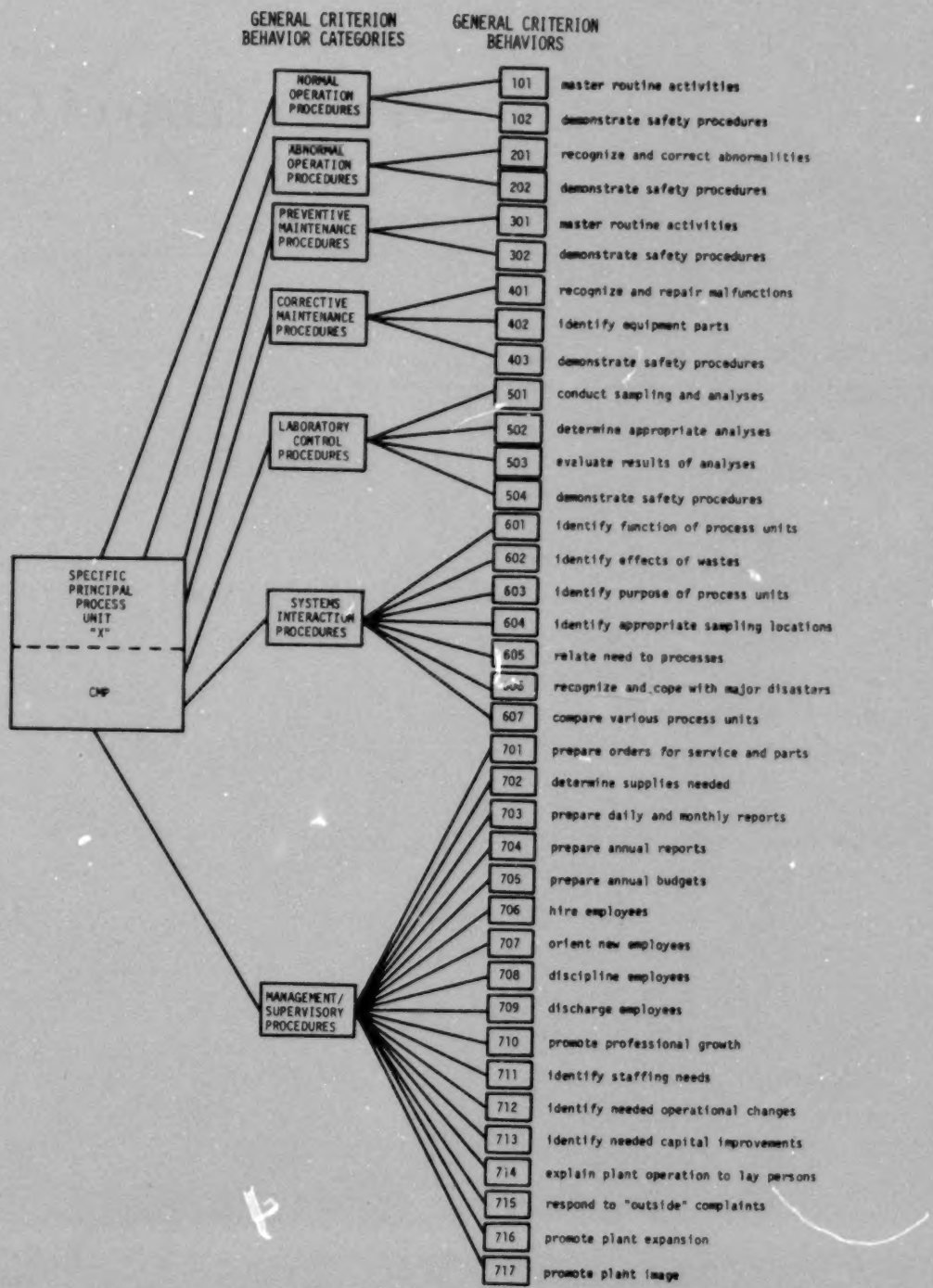

GENERAL CRITERION BEHAVIOR CATEGORIES
GENERAL CRITERION BEHAVIORS
NORMAL OPERATION PROCEDURES
ABNORMAL OPERATION PROCEDURES
PREVENTIVE MAINTENANCE PROCEDURES
CORRECTIVE MAINTENANCE PROCEDURES
LABORATORY CONTROL PROCEDURES
SYSTEMS INTERACTION PROCEDURES
MANAGEMENT/ SUPERVISORY PROCEDURES
SPECIFIC PRINCIPAL PROCESS UNIT "X"
CMP
101 master routine activities
102 demonstrate safety procedures
201 recognize and correct abnormalities
202 demonstrate safety procedures
301 master routine activities
302 demonstrate safety procedures
401 recognize and repair malfunctions
402 identify equipment parts
403 demonstrate safety procedures
501 conduct sampling and analyses
502 determine appropriate analyses
503 evaluate results of analyses
504 demonstrate safety procedures
601 identify function of process units
602 identify effects of wastes
603 identify purpose of process units
604 identify appropriate sampling locations
605 relate need to processes
606 recognize and cope with major disasters
607 compare various process units
701 prepare orders for service and parts
702 determine supplies needed
703 prepare daily and monthly reports
704 prepare annual reports
705 prepare annual budgets
706 hire employees
707 orient new employees
708 discipline employees
709 discharge employees
710 promote professional growth
711 identify staffing needs
712 identify needed operational changes
713 identify needed capital improvements
714 explain plant operation to lay persons
715 respond to "outside" complaints
716 promote plant expansion
717 promote plant image

Figure 1: Relationship of general criterion behaviors (performance objectives) to the general categories and composite model plant (CMP).

Performance Objectives

When the treatment plant operators, educators, consultants and representatives from professional water pollution control organizations came together to develop an effective instructional program, they recommended the use of performance or behavioral objectives because such objectives clearly outline:

1. What the student is expected to do as a result of the instructional program.
2. The conditions under which the student shall do it.
3. The standard of performance.

COMPOSITE MODEL PLANT

First, they developed a composite model plant (CMP) of twenty-two process units which is really many wastewater treatment plants in one model. Such a mix of process units seldom occurs in a treatment plant, but if a student becomes competent in the operation and management of the CMP he should be able to perform successfully in any treatment plant.

TASK ANALYSIS

Next, to ensure that the materials were specifically tailored to what the operator does on the job, a task analysis was conducted. They found that the tasks which an operator performs fell into seven general categories which were further divided into 37 tasks or general behaviors. (See figure 1, page vi.) The tasks were organized under:

1. Normal Operation Procedures. These include routine operating activities that do not vary significantly from day to day and that are designed to keep the plant functioning within a normal range of values. For example, the employee conducts routine samplings of the primary sludge and inspects pumping equipment and the wastestream to verify that the process is functioning properly.

2. Abnormal Operation Procedures. These include activities of the plant employee that result from unusual and undesirable conditions of the wastestream. The abnormal procedures enable the plant employee to recognize when the wastestream is abnormal and to return it to an acceptable, normal condition. An abnormal wastestream results when a normal operation procedure is not properly applied, a corrective maintenance procedure is needed or management/supervisory procedures are poor. For example, the plant employee should recognize that a black septic primary sludge sample is an abnormal condition of the wastestream and take appropriate action.

3. Preventive Maintenance Procedures. These include routine maintenance activities of the plant employee which prevent major equipment breakdown and subsequent corrective maintenance. For example, the employee would lubricate bearings and other moving parts, replace worn components and adjust components of the primary sludge pumps.

4. Corrective Maintenance Procedures. These include maintenance activities of the plant employee that usually result from the breakdown or malfunction of a unit of equipment or a component. For example, the employee would notice whether the primary sludge pump is malfunctioning and know when and how to correct the disorder or when and how to refer the problem to plant maintenance personnel.

5. Laboratory Control Procedures. These include special and routine activities relating to laboratory analysis, the specification of sampling procedures and locations and the general management of the laboratory facilities. For example, the employee would collect primary sludge samples and conduct the analyses.

6. Systems Interaction Procedures. These include activities of the plant employee which relate the functioning of specific units of equipment to other process units and to the system as a whole. For example, the employee would determine how the effective functioning of the primary sludge pumps relates to digester performance.

7. Management/Supervisory Procedures. These include activities relating to employment practices, record keeping, plant operation policy and the establishment of a constructive and realistic rapport between the plant and the community it serves. For example, the employee would keep records on primary sludge pumping, keep an inventory of spare parts and evaluate the adequacy of maintenance procedures by shift personnel.

CURRICULUM DESIGN

After deciding what process equipment an operator must operate and maintain, and finding out what an operator does through the task analysis, they listed the objectives a student must master to successfully operate a treatment plant. For example, the student will describe and perform the normal inspection procedure for the primary sedimentation unit including frequency of inspection, conditions to look for and the actions he should take.

INSTRUCTOR'S GUIDES

The next step was the design of manuals to guide the instructor. In the guides varied learning activities and imaginative innovations which produce more learning than traditional teaching methods are emphasized. The instructional suggestions do not need to be followed slavishly, but should be modified and improved as much as possible.

The instructor's goal is to achieve the objectives of the curriculum by selecting activities which suit the student's needs and help him to master all the information and skills in the course. The most effective learning occurs when the student is a participant in the learning process, not a spectator.

An instructor should use learning activities which approximate the situations which the student will meet *in the treatment plant.* If it is not possible to teach in a treatment plant, *simulated situations* should be set up in the workshop or classroom so that the student can solve rather than discuss problems. *Group discussion* stimulated by *visual materials* is an effective learning technique. Lecturing, however, is inefficient. Because the student is not actively involved during a lecture, the instructor should use lectures sparingly.

Introduction to Modules of Instruction

In this instructor's guide the topics and ideas are presented as a series of modules, organized around the general objectives stated in the course descriptions for Plant Operation I, II, III and IV and the In-Plant Practicum which are found in the *Program Implementation Procedures* of the *CEWT Program*. Each module is designed to help the instructor plan a course of study for the operation of a treatment process using the CMP process unit. Each module is organized around sixteen objectives common to all processes.

The modules in *Plant Operations for Wastewater Facilities* are arranged in the order in which the CMP process units occur in the treatment plant. Each process is identified by a letter of the alphabet and the process unit is described in the heading of the module. If the instructor uses the modules in consecutive order, he and his students will follow the treatment of the wastestream from collection to its discharge into the receiving waters. Each module is designed so it can be used as a minicourse in a treatment process. Instructors are urged to group the modules to suit their individual curriculum needs and instructional situations.

Material in the modules can easily be adapted for courses which upgrade the training of operators in normal operation procedures, abnormal operation procedures, preventive maintenance procedures or corrective maintenance procedures by grouping the appropriate objectives from all the modules. For example, an instructor could develop a course in corrective maintenance by grouping objectives 11 and 12 from each module.

INSTRUCTIONAL PROCESS UNITS

Each module assumes that the composite model plant unit will be used for instruction in the process. If the recommended unit is not available, an alternate process unit may be substituted and the instructional materials adapted. The recommended CMP units and alternate units for all the processes are listed in table 1, page 4. Two modules on sludge dewatering are included because it is impossible for a student to master operation of this process by learning to operate one process unit. Remember, however, that a student will be more adequately prepared to work in almost any treatment plant if he is trained on the CMP unit. When it is not possible to use the recommended unit, students should be informed about the operation and function of the unit and hands-on training should be conducted on the best alternate unit available.

PURPOSE OF THE MODULES

The modules in *Plant Operations for Wastewater Facilities* help the student to learn how to operate all the process units in the wastewater treatment plant. Normal operation, abnormal operation, preventive maintenance and corrective maintenance procedures are included. When the course is completed, he will know why each unit is

TABLE I

SPECIFIC PROCESS UNITS RECOMMENDED FOR USE IN IMPLEMENTATION OF THE TWO-YEAR POST HIGH SCHOOL WASTEWATER TECHNOLOGY INSTRUCTIONAL PROGRAM

Module	Process	CMP Unit	Recommended Teaching Unit	Alternate Teaching Unit
1	Collection	A	Combined system with industrial waste	Sanitary system with industrial waste
2	Chlorination	B	Vacuum chlorinator with automatic feed to pipe, pneumatic control and electric evaporator	Vacuum chlorinator with automatic feed to pipe, electrical control and electric evaporator
		N	Vacuum chlorinator with automatic feed to pipe and closed-loop pneumatic control	Vacuum chlorinator with automatic feed to pipe and closed electrical control
3	Screening and Grinding	C	Mechanically cleaned bubbler control unit with grinder	Mechanically cleaned electrode control unit with grinder
4	Grit Removal	D	Aerated unit with bucket elevator	Aerated unit with screw conveyor
5	Primary Sedimentation	E	Rectangular unit with telescopic valve drawoff, density meter time clock and trough with scraper	Circular unit with telescopic valve drawoff, density meter time clock and trough with scraper
6	Trickling Filtration	F	Rotary distributor, standard rate unit with dosing tank	Rotary distributor, high rate unit
7	Aeration	G	Diffused air unit with swing-type diffuser producing fine bubbles	Mechanical aeration unit with turbine and sparger
8	Secondary Sedimentation	H	Circular, peripheral-feed unit with suction	Circular, center-feed unit with suction
9	Pond Stabilization	I	Aerobic pond	Facultative pond
10	Thickening	J	Floatation unit with air	Floatation unit with vacuum
11	First Stage Digestion	K	Fixed cover, gas recirculation unit with external heat exchanger	Floating cover, gas recirculation unit with external heat exchanger

4
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

12	Second Stage Digestion	L	floating cover unit with gas storage	Fixed cover unit
13	Sludge Conditioning	M	Chemical conditioning unit with counter-current elutriation	None
14a	Sludge Dewatering	O	Vacuum filter unit with cloth	Vacuum filter unit with coil
14b	Sludge Dewatering	O	Continuous feed centrifuge	None
15	Solids Disposal	P	Multiple hearth incinerator unit	Fluidized bed incinerator unit
16	Effluent Disposal	Q	Direct reuse system	Underground disposal system
17	Flow Measurement	R	Centralized recording and totalizing system including Parshall flume, Venturi meter, magnetic flowmeter and rotameter	None
18	Pumping and Piping	S	System with magnetically connected, pneumatically controlled, diesel driven, centrifugal pumps; speed reducer connected, electrically controlled, motor driven, positive displacement pumps and appropriate piping	None
19	Electric Power	T	System using delta transformers, generators, electrical switchgear, automatic gear, automatic circuit actuators on motors and telemetering with alarms.	System using Y transformers, generators, electrical switchgear, automatic circuit actuators on motors and telemetering with alarms
20	Gas Power	U	System with internally produced gas with high pressure tanks and rotary positive displacement compressors	System with internally produced gas with high pressure tanks and reciprocating compressors

important to the treatment plant and how it affects and interacts with other process units in the treatment system.

STUDENT PREREQUISITES

Completion of Introduction to Environmental Technology and courses in basic mathematics and biology qualify the student to enter the course in Unit Operations for Wastewater Facilities. Concurrent courses in basic chemistry and laboratory control are suggested. (See pages 7 to 19 of *Program Implementation Procedures.*)

TERMINAL OBJECTIVE

When the student has completed the modules of instruction in this course, he should be able to do the following for each of the processes in the treatment plant:

1. Identify the process unit.
2. Describe the process unit in technical and nontechnical terms.
3. Describe the safety procedures for the process unit and explain how the procedures protect employees and visitors.
4. Identify the components of the process unit. Explain the purpose of each component, how the component works and why it is important.
5. Describe the normal operation procedures for the process unit components.
6. Perform the normal operation procedures for the process unit.
7. Describe and perform the start-up and shut-down procedures for the process unit.
8. Describe the abnormal operation procedures for the process unit.
9. Describe the preventive maintenance procedures for the process unit.
10. Perform the preventive maintenance procedures for the process unit.
11. Describe the corrective maintenance procedures for the process unit components.
12. Perform the corrective maintenance procedures for the process unit components.
13. Perform the safety procedures for the process unit and demonstrate how they protect employees and visitors.
14. Compare other process units to the composite model plant unit.
15. Name and locate the components of the process unit. Name and select reference materials which explain the normal operation procedures, the purpose of each component, how the component works and why it is important.
16. Perform the abnormal operation procedures for the process unit.

RESOURCES

The listing of instructional resources suggests materials now available to instructors to accomplish the desired performance in the student.

Instructional materials 1 to 1866 are keyed to the reference, *Instructional Materials Available* which is available from:

Office of Water Program Operations
US Environmental Protection Agency
Washington, DC 20460

Two companion volumes to *Instructional Materials Available*, also available from EPA, offer suggestions for selecting audio-visual equipment:

Selecting Audio-Visual Equipment
Selecting Instructional Media and Instructional Systems

The following journals list addresses of companies from whom literature about the process units which they manufacture can be obtained:

"Environmental Science and Technology"
1155 Sixteenth Street, N.W.
Washington, DC 20036

"Water and Sewage Works"
434 South Wabash
Chicago, IL 60605

"Water and Wastes Engineering"
666 Fifth Avenue
New York, NY 10019

If suitable materials are not available, instructors are urged to develop their own resources.

FORMAT OF THE MODULES

The module begins with a statement of purpose which explains what the student will be studying. Next, all the objectives of the module and code numbers keyed to a computerized list of instructional resources are listed for the instructor's convenience.

Objectives. Each module includes sixteen objectives which bring the student to the performance level required by the terminal objective. The knowledge and skills demanded of the student become more complex as he progresses through the sixteen objectives in a module. He begins by identifying components and learning facts about the components and processes. He uses these facts to develop concepts and ideas. Finally, he relates the concepts and ideas to each other so that he can make decisions about plant procedures.

A glossary of verbs which follows this introduction defines the verbs used in the objectives so that the instructor is aware of what he is instructing the student to do and so that his evaluation of the student is based solely on what is stated in the objective.

Conditions. The conditions define the circumstances under which the student performs and is evaluated and lists the information, equipment and assistance to which the student will have access. The best available learning and testing conditions should be used. A process unit in a treatment plant or workshop has more impact on the students than photographs and drawings. For example, if the student is to be given a process unit, unit components, photographs or diagrams of a unit, the instructor should provide a process unit. If a process unit is not available, he would use components of the unit in combination with photographs of those components which he does not have available. Line drawings and diagrams should not be used if photographs and manufacturers' illustrations are available.

Acceptable Performance. The acceptable performance expands the objective and details the steps a student must follow to reach the objective. To move on to the next objective, at least 70% of each step or category must be mastered with no repeated errors between modules. For example, no student can complete the course of study if he consistently fails to give attention to moving parts as he

performs safety procedures or to describe the odor as he evaluates the characteristics of the wastestream. In this section the instructor will find the main topics of his lesson plan and for the evaluation of the student's performance.

Instructor Activity. The instructor should get to know his class by working with small groups and with each student. He should encourage students to learn from each other as they work together. He should involve the student in the instructional and learning process. Instructional activities are paired numerically with student activities.

Student Activity. This is a listing of activities which the student will take part in, in order to accomplish the specified performance.

EVALUATION TECHNIQUE

The instructor may use or adapt the learning activities listed under instructor activity and student activity as evaluation techniques. The technique chosen should reflect what the objective asks the student to do. For example, if a student is asked to *describe*, the evaluation technique is a *description*. The student should be evaluated under the conditions and to the performance level required for each objective.

Glossary of Verbs

The glossary of verbs is included here so that the instructor will know exactly what the student is being asked to do to meet his objective. Notice the difference, for example, between the meanings of *identify* and *name*. When a student is asked to identify, the instructor is providing the name of the thing to be identified. But, when the student must name something, he must supply the name.

The list includes all the verbs from the objectives and the acceptable performance sections of all the modules, as well as some verbs used in the instructor and student activities.

	DEFINITION	APPLICATION
APPLY	To make use of as suitable, fitting or relevant.	Apply the preventive maintenance schedule for the second stage digestion unit.
CHECK	To inspect and ascertain the condition of, especially in order to determine that the condition is satisfactory.	Check the characteristics of each component.
COMMENT ON	To express an opinion or attitude about what has been seen or heard.	Comment on employee safety procedures.
COMPARE	To examine the character or qualities of, especially for the purpose of discovering resemblances or differences.	Compare other aeration units to the diffused air unit with swing-type diffuser producing fine bubbles.
CONSIDER	To give thought to with a view to purchasing, accepting or adopting.	Consider availability of replacement parts, capital costs, ease of repair, efficiency, maintenance costs, and so forth.
CORRECT	To alter or adjust to bring to some standard or required condition.	Correct the malfunction.
DEMONSTRATE	To illustrate or explain in an orderly and detailed way with many examples, specimens and particulars.	Demonstrate the start-up procedures in a treatment plant.

	DEFINITION	APPLICATION
DESCRIBE	To represent by words written or spoken for the knowledge or understanding of others, to transmit an image of the identifying features, the nature and characteristics of objects, events and actions.	Describe the safety procedures for the screening and grinding unit.
DEVELOP	To produce or generate.	Develop a picture file of first stage digestion units.
DISCUSS	To talk about, to present in detail, to exchange views or information about.	Discuss treatment plant case histories.
EVALUATE	To examine and make a judgement about quality, significance, amount, degree or condition of.	Evaluate the wastestream for abnormal conditions.
EXPLAIN	To make plain or clear, to present in detail.	Explain the purpose of each component, how the component works and why it is important.
IDENTIFY	To establish the identity of, pick out or single out an object in response to its name by pointing, picking up, underlining, marking or other responses.	Identify the components of the chlorination unit.
INDICATE	To state or express without going into detail.	Indicate whether the process unit is used for secondary sedimentation.
INSPECT	To view closely and critically, to determine quality or state, to detect errors or otherwise appraise.	Inspect a treatment plant.
LIST	To enumerate or specify.	List routine calculations for the pond stabilization unit.
LOCATE	To stipulate the position of an object in relation to other objects.	Locate the components of the trickling filtration unit.

	DEFINITION	APPLICATION
NAME	To supply the correct name, in oral or written form, for an object, class of objects, persons, places, conditions or events which are pointed out or described.	Name the components of the primary sedimentation unit.
OBSERVE	To pay careful, directed, analytical attention to.	Observe the thickening process during a plant tour.
PERFORM	To carry out an action or pattern of behavior. (Implies an act for which a process or pattern of movement has already been established, especially one calling for skill or precision, or for the assignment or assumption of responsibility.)	Perform the normal operation procedures for the grit removal unit.
POINT OUT	To indicate the position or direction of, especially by extending a finger toward the thing so indicated, to direct someone's attention to.	Point out characteristics which distinguish the first stage digestion unit from other units.
RECOMMEND	To mention or introduce as being worthy of acceptance, use or trial, to advise.	Recommend procedures to correct the unsafe conditions.
SELECT	To choose something from a number or group usually by fitness, excellence, or other distinguishing feature.	Select the reference materials and tools needed to perform the corrective maintenance.

MODULE 14A

SLUDGE DEWATERING

A vacuum filter unit with cloth

Composite Model Plant Unit O

PURPOSE: *In this module the student will learn to perform all the activities in the objectives as they apply to a vacuum filter unit with cloth. READ PAGES 1 TO 11 BEFORE USING THIS MODULE.*

OBJECTIVES:

14a.1 *Identify the sludge dewatering unit.*

14a.2 *Describe the sludge dewatering process in technical and non-technical terms.*

14a.3 *Describe the safety procedures for the sludge dewatering unit and explain how the procedures protect employees and visitors.*

14a.4 *Identify the components of a sludge dewatering unit. Explain the purpose of each component, how the component works and why it is important.*

14a.5 *Describe the normal operation procedures for the sludge dewatering unit components listed on page 17.*

14a.6 *Perform the normal operation procedures for the sludge dewatering unit.*

14a.7 *Describe and perform the start-up and shut-down procedures for the sludge dewatering unit.*

14a.8 *Describe the abnormal operation procedures for the sludge dewatering process.*

14a.9 *Describe the preventive maintenance procedures for the sludge dewatering unit.*

14a.10 *Perform the preventive maintenance procedures for the sludge dewatering unit.*

14a.11 *Describe the corrective maintenance procedures for the sludge dewatering unit components listed on page 17.*

14a.12 *Perform the corrective maintenance procedures for the sludge dewatering unit components.*

14a.13 *Perform the safety procedures for the sludge dewatering unit and demonstrate how they protect employees and visitors.*

14a.14 *Compare other sludge dewatering units to the vacuum filter unit with cloth (composite model plant unit O).*

14a.15 *Name and locate the components of the sludge dewatering unit listed on page 17. Name and select reference materials which explain the normal operation procedures, the purpose of each component, how the component works and why it is important.*

14a.16 Perform the abnormal operation procedures for the sludge dewatering unit.

RESOURCES: 3 116 120 125 141 143 144 307 308 309 316 317 320 321 324 421 459 511 551 552 553 554 937 990 1033 1034 1399

<<<<<<>>>>>>

OBJECTIVE 14a.1: *Identify the sludge dewatering unit.*

CONDITIONS: Given a unit, a model of a unit or a photograph of a unit.

ACCEPTABLE PERFORMANCE: The student will:

Indicate whether the process unit is used for sludge dewatering.

INSTRUCTOR ACTIVITY:

1. Point cut characteristics which distinguish the sludge dewatering unit from other process units.

STUDENT ACTIVITY:

1. Develop a picture file of sludge dewatering units. Mark distinguishing characteristics.

<<<<<<>>>>>>

OBJECTIVE 14a.2: *Describe the sludge dewatering process in technical and nontechnical terms.*

CONDITIONS: Given photographs of the sludge dewatering unit.

ACCEPTABLE PERFORMANCE: The student will:

Describe the sludge dewatering unit, explaining the meaning of vacuum filtration.

Describe the purpose of sludge dewatering.

Describe how sludge dewatering affects:
- solids disposal
- pumping and piping
- effluent disposal

INSTRUCTOR ACTIVITY:

1. Use diagrams, photographs and slides to describe sludge dewatering.
2. Describe the sludge dewatering process during a plant tour. React to the student's description of the process.

STUDENT ACTIVITY:

1. Describe the sludge dewatering process while viewing photographs, diagrams and slides.
2. Observe and describe the sludge dewatering process during a plant tour.

<<<<<<>>>>>>

OBJECTIVE 14a.3: *Describe the safety procedures for the sludge dewatering unit and explain how the procedures protect employees and visitors.*

CONDITIONS: Given a list of operation and maintenance procedures.

ACCEPTABLE PERFORMANCE: The student will:

Describe the safety procedures for the sludge dewatering unit, commenting on:
- High-risk activities
  - removing debris from channels
  - working with switches in automatic position
- Sources of danger
  - acid wastes
  - caustic wastes
  - chemical slurries
  - deep wells
  - electrical equipment
  - explosive gases
  - moving parts
  - open doors and covers
  - slippery walks
  - toxic gases
  - welding torches

Safety equipment
- belt guards
- fire-fighting equipment
- first-aid kit
- lockout tags and keys
- proper lighting
- protective clothing
- railings
- stair safety treads
- ventilation system

Explain how the procedures protect employees and visitors.

INSTRUCTOR ACTIVITY:

1. Discuss treatment plant case histories.
2. Describe the conditions in a plant and ask for evaluation.
3. Describe the safety procedures for each operation and maintenance procedure.
4. Prepare slides of sources of danger and high-risk activities.

STUDENT ACTIVITY:

1. Read case histories and comment on employee safety procedures.
2. Evaluate conditions which the instructor has described. Suggest remedies.
3. Role play operation or maintenance procedures. Select proper safety equipment and name the sources of danger and high-risk activities. Develop a manual of safety procedures for the sludge dewatering unit.
4. Identify sources of danger and high-risk activities pictured in slides.

<<<<<<>>>>>>

OBJECTIVE 14a.4: *Identify the components of a sludge dewatering unit. Explain the purpose of each component, how the component works and why it is important.*

CONDITIONS: Given a sludge dewatering unit, unit components or a diagram, model or photographs of a unit and a list of components.

ACCEPTABLE PERFORMANCE: The student will:

Identify components of the sludge dewatering unit and associated equipment:

agitator	mixing tank
air receiver	oil valve
blower	piping
chemical conditioner	roller
chemical feeder	rotameter
conveyor belt	scraper
drum	sludge pump
filter media	vacuum gage
filtrate pump	vacuum pump
fire-fighting equipment	valve
first-aid kit	

Explain the purpose of each component, how the component works and why it is important.

INSTRUCTOR ACTIVITY:

1. Point out and name components in diagrams, photographs or models.
2. Arrange photographs or models of components in the workshop for student identification.
3. Point out and name components during a plant tour.
4. Question the students about the purpose of each component, how the component works and why it is important.

STUDENT ACTIVITY:

1. Identify the components which the instructor names on diagrams, photographs or models.
2. Identify the components at stations in the workshop in writing.
3. Identify components during a plant tour.
4. Explain the purpose of each component, how the component works and why it is important.

<<<<<<>>>>>>

OBJECTIVE 14a.5: *Describe the normal operation procedures for the sludge dewatering unit components listed above.*

CONDITIONS: Given a sludge dewatering unit or slides or photographs of a sludge dewatering unit, a list of components of the unit, a checklist of characteristics and a normal operation procedures manual.

ACCEPTABLE PERFORMANCE: The student will:

Describe the characteristics of each component which the operator checks to determine whether the component is functioning normally, commenting on:

color	pressure
corrosion	sound
flow	temperature
motion	vacuum
odor	vibration
position	

Name the sense or indicator which monitors each characteristic.

Explain how often the characteristics of each component must be checked and why the component must be checked on this schedule.

Describe what an operator does if the characteristics of a component indicate that it is not functioning normally, including:
- making adjustments
- deciding about corrective maintenance
- reporting to supervisors
- reporting in written records

Explain why a component's characteristics must be returned to normal.

Describe routine sampling for the sludge dewatering process.

List routine calculations for the sludge dewatering process.

Describe routine procedures for recording data.

INSTRUCTOR ACTIVITY:

1. Describe the characteristics of the components of the sludge dewatering unit.
2. Describe the normal operation procedures for the sludge dewatering unit. Use color pictures.
3. Describe the normal operation procedures during a slide show of components of the sludge dewatering unit.
4. Describe and explain the normal operation procedures during a plant tour. Listen to the student's description of the procedures.

STUDENT ACTIVITY:

1. Develop a checklist, listing the components of the

sludge dewatering unit and their normal characteristics.
2. Develop a manual of normal operation procedures.
3. Describe the normal operation procedures during a slide show of components of the sludge dewatering unit.
4. Observe and describe the normal operation procedures during a plant tour.

<<<<<<>>>>>>

OBJECTIVE 14a.6: *Perform the normal operation procedures for the sludge dewatering unit.*

CONDITIONS: Given a sludge dewatering unit, the manual of normal operation procedures which the student has developed for the sludge dewatering unit and basic references.

ACCEPTABLE PERFORMANCE: The student will:

Check and evaluate the characteristics of each component, explaining his actions.

Perform the procedures which an operator follows if the characteristics of a component indicate that it is not functioning normally.

Perform the routine sampling.

Perform the routine calculations.

Perform the routine record keeping.

INSTRUCTOR ACTIVITY:
1. Observe the student demonstrating normal operation procedures in a dry run in a treatment plant.
2. Observe the student performing normal operation procedures in a treatment plant.

STUDENT ACTIVITY:
1. Demonstrate the normal operation procedures in a dry run in a treatment plant.
2. Perform and explain the normal operation procedures in a treatment plant.

<<<<<<>>>>>>

OBJECTIVE 14a.7: *Describe and perform the start-up and shut-down procedures for the sludge dewatering unit.*

CONDITIONS: Given a mock-up, model or photograph of a sludge dewatering unit and a sludge dewatering unit with the manufacturer's operation manual.

ACCEPTABLE PERFORMANCE: The student will:

Start up and shut down a sludge dewatering unit, following the manufacturer's instructions.

INSTRUCTOR ACTIVITY:

1. Demonstrate and perform the start-up procedures in a treatment plant.
2. Demonstrate and perform the shut-down procedures in a treatment plant.
3. Observe the student performing the start-up procedures in a treatment plant.
4. Observe the student performing the shut-down procedures in a treatment plant.
5. Observe the student as he evaluates his start-up procedures.
6. Observe the student as he evaluates his shut-down procedures.

STUDENT ACTIVITY:

1. Describe the start-up procedures in a dry run in a treatment plant.
2. Describe the shut-down procedures in a dry run in a treatment plant.
3. Perform the start-up procedures in a treatment plant.
4. Perform the shut-down procedures in a treatment plant.
5. Evaluate the operation of the sludge dewatering unit to determine whether correct start-up procedures have been used. Use the normal operation procedures manual which the student has developed. (See objective 1.4.)
6. Evaluate the operation of the sludge dewatering unit to determine whether correct shut-down procedures have been used. Use the normal operation procedures manual which the student has developed. (See objective 1.4.)

<<<<<<>>>>>>

OBJECTIVE 14a.8: *Describe the abnormal operation procedures for the sludge dewatering process.*

CONDITIONS: Given a wastestream in a treatment plant or color photographs of a wastestream, a checklist of the conditions of the wastestream and plant records and reference materials.

ACCEPTABLE PERFORMANCE: The student will:

Evaluate the wastestream for abnormal conditions, commenting on:

alkalinity	level
filterability	pH
flow	sludge density

Describe the cause and effect of the abnormal condition.

Explain how often the condition of the wastestream must be checked.

Describe what an operator does if he observes abnormal conditions, including:
- operational changes
- reporting to supervisors
- sampling procedures

Describe how the actions of the operator will improve the condition of the wastestream.

INSTRUCTOR ACTIVITY:

1. Describe and explain the abnormal conditions of the wastestream illustrated in color pictures.
2. Describe and explain the abnormal operation procedures illustrated in pictures and described in plant records and case histories.
3. Describe and explain the abnormal operation procedures during a slide show.
4. Describe and explain the abnormal operation procedures during a plant tour. Listen to the student's description of the procedures.

STUDENT ACTIVITY:

1. Evaluate and explain the abnormal conditions of the wastestream which are illustrated in color pictures.
2. Describe and explain the abnormal operation procedures illustrated in pictures and described in plant records and case histories.

3. Describe and explain the abnormal operation procedures in a class discussion after a slide show.
4. Evaluate and explain the condition of the wastestream during a plant tour. Describe and explain the abnormal operation procedures.

<<<<<<>>>>>>

OBJECTIVE 14a.9: *Describe the preventive maintenance procedures for the sludge dewatering unit.*

CONDITIONS: Given a sludge dewatering unit or pictures and drawings of a sludge dewatering unit and reference materials, including:

inspection records
manufacturer's maintenance guides
plant drawings and specifications
preventive maintenance schedule

ACCEPTABLE PERFORMANCE: The student will:

Describe these preventive maintenance procedures for the sludge dewatering unit:

- Cleaning
  - blower
  - chemical conditioner
  - chemical feeder
  - filter media
  - pumps
    - filtrate
    - sludge
    - vacuum
  - roller
  - scraper
- Lubrication
  - agitator
  - blower
  - chemical conditioner
  - chemical feeder
  - oil valve
  - pumps
    - filtrate
    - sludge
    - vacuum
- Mechanical adjustment
  - agitator
  - blower
  - chemical conditioner
  - chemical feeder
  - conveyor belt
  - mixing tank
  - oil valve
  - pumps
    - filtrate
    - sludge
    - vacuum
  - roller
  - scraper
  - vacuum gage
  - valve
- Painting
  - agitator
  - air receiver
  - blower
  - chemical conditioner
  - chemical feeder
  - drum
  - mixing tank
  - piping

Painting (continued)	fire-fighting equipment
pumps	first-aid kit
filtrate	rotameter
sludge	Wear measurement
vacuum	conveyor belt
Replacement	roller
filter media	scraper

Name the reference materials and tools needed to perform the preventive maintenance procedures.

Explain how often each preventive maintenance procedure must be performed.

Explain how an operator determines whether a component needs preventive maintenance.

Describe what an operator does if a component needs preventive maintenance.

Explain why each preventive maintenance procedure is important.

INSTRUCTOR ACTIVITY:

1. Describe and explain the preventive maintenance procedures for the sludge dewatering unit.
2. Describe and explain the preventive maintenance procedures during a slide show.
3. Describe and explain the preventive maintenance procedures during a plant tour.

STUDENT ACTIVITY:

1. Develop a preventive maintenance schedule and a manual of preventive maintenance procedures.
2. Observe, describe and explain the preventive maintenance procedures during a slide show.
3. Observe, describe and explain the preventive maintenance procedures during a plant tour.

<<<<<<>>>>>>

OBJECTIVE 14a.10: *Perform the preventive maintenance procedures for the sludge dewatering unit.*

CONDITIONS: Given a sludge dewatering unit and tools and reference materials, including:

inspection records
manufacturer's maintenance guides
plant drawings and specifications
preventive maintenance schedule

ACCEPTABLE PERFORMANCE: The student will:

Select the reference materials and tools needed to perform the preventive maintenance procedures.

Apply the preventive maintenance schedule for the sludge dewatering unit, explaining his actions.

Perform the procedures which an operator follows when a component needs preventive maintenance, explaining his actions.

INSTRUCTOR ACTIVITY:

1. Set up simulated situations in the workshop.
2. Observe student inspection of a treatment plant.
3. Observe the student performing the preventive maintenance procedures in a treatment plant.

STUDENT ACTIVITY:

1. Small groups of students perform the preventive maintenance procedures in simulated situations in the workshop.
2. Inspect a treatment plant. Evaluate and explain the preventive maintenance procedures.
3. Perform and explain the preventive maintenance procedures in a treatment plant.

<<<<<<>>>>>>

OBJECTIVE 14a.11: *Describe the corrective maintenance procedures for the sludge dewatering unit components listed on page 17.*

CONDITIONS: Given a sludge dewatering unit or a mock-up, photographs or drawings of a sludge dewatering unit, the manual of operation procedures which the student has developed for the sludge dewatering unit, tools and reference materials, including:

catalogue of replacement parts
equipment catalogues
manufacturer's maintenance guides

ACCEPTABLE PERFORMANCE: The student will:

Describe how an operator evaluates each component of the sludge dewatering unit for corrective maintenance, commenting on:

color
corrosion
flow
motion

odor
position
pressure
sound
temperature
vacuum
vibration

Explain why a component has malfunctioned.

Name the reference materials and tools needed to perform the corrective maintenance.

Describe what an operator does when he discovers a malfunction, including:
- evaluation of capabilities of plant personnel to perform the procedures
- selection of replacement parts
- record keeping

Describe how the operator corrects the malfunction.

INSTRUCTOR ACTIVITY:

1. Describe and explain the corrective maintenance procedures for the sludge dewatering unit, using diagrams and pictures.
2. Describe and explain the corrective maintenance procedures during a slide show.
3. Describe and explain the corrective maintenance procedures during treatment plant tours.

STUDENT ACTIVITY:

1. Describe and explain the corrective maintenance procedures in situations described or pictured by the instructor.
2. Describe and explain the corrective maintenance procedures during a slide show.
3. Observe, describe and explain the corrective maintenance procedures during a treatment plant tour.

<<<<<<>>>>>>

OBJECTIVE 14a.12: *Perform the corrective maintenance procedures for the sludge dewatering unit components.*

CONDITIONS: Given a sludge dewatering unit or unit components, the operation procedures manual which the student has developed, tools and reference materials, including:
- catalogue of replacement parts
- equipment catalogues
- manufacturer's maintenance guides
- manufacturer's operation manual

ACCEPTABLE PERFORMANCE: The student will:

Evaluate the components of the sludge dewatering unit for corrective maintenance, explaining why a component has malfunctioned and commenting on:

- color
- corrosion
- flow
- motion
- odor
- position
- pressure
- sound
- temperature
- vacuum
- vibration

Select the reference materials and tools needed to perform the corrective maintenance.

Perform the procedures which an operator follows when a component malfunctions, including:

- evaluation of capabilities of plant personnel to perform the procedures
- selection of replacement parts
- record keeping

Correct the malfunction.

INSTRUCTOR ACTIVITY:

1. Set up simulated situations in the workshop.
2. Observe the student as he evaluates the components in a treatment plant.
3. Observe the student performing the corrective maintenance procedures in a treatment plant.

STUDENT ACTIVITY:

1. Small groups of students perform and explain the corrective maintenance procedures in simulated situations in the workshop.
2. Evaluate the components for corrective maintenance.
3. Perform and explain the corrective maintenance procedures in a treatment plant.

<<<<<<>>>>>>

OBJECTIVE 14a.13: *Perform the safety procedures for the sludge dewatering unit and demonstrate how they protect employees and visitors.*

CONDITIONS: Given a list of operation or maintenance procedures, the student's manual of safety procedures, tools and safety equipment.

ACCEPTABLE PERFORMANCE: The student will:

Identify hazardous conditions in the sludge dewatering unit, commenting on:
- high-risk activities
- sources of danger
- safety equipment

Explain how the procedures protect employees and visitors.

Recommend corrective procedures and correct the unsafe condition.

INSTRUCTOR ACTIVITY:

1. Set up simulated situations in the workshop.
2. Observe the student as he evaluates the safety conditions in a treatment plant.
3. Observe the student performing the safety procedures in a treatment plant.

STUDENT ACTIVITY:

1. Evaluate safety conditions in simulated situations and recommend corrective procedures.
2. Evaluate safety conditions in a treatment plant and recommend corrective procedures.
3. Perform the safety procedures in a treatment plant.

<<<<<<>>>>>>

OBJECTIVE 14a.14: *Compare other sludge dewatering units to the vacuum filter unit with cloth (composite model plant unit 0).*

CONDITIONS: Given a process unit and reference materials, including:
- equipment catalogues
- laboratory reports
- manufacturer's bulletins
- manufacturer's operation manuals
- plant maintenance and operation records

ACCEPTABLE PERFORMANCE: The student will:

Compare composite model plant unit 0 with:
- a continuous feed centrifuge.
- a vacuum filter unit with coil.

Consider:
availability of replacement parts
capital costs
dependency on surrounding environment
ease of repair
efficiency
flow-handling capabilities
maintenance costs
nuisance to neighbors
operational costs
operational skills
personnel requirements
reliability
resistance to upset
sensitivity of controls
space requirements
waste-handling capabilities

INSTRUCTOR ACTIVITY:

1. Prepare a chart for tabulation of information about the units.
2. Compare composite model plant unit 0 with the other units.
3. Help the student to collect information for reports on the advantages and disadvantages of each unit.

STUDENT ACTIVITY:

1. List information about the units on a chart.
2. Compare the units in a panel discussion.
3. Write a report on the advantages and disadvantages of each unit.

<<<<<<>>>>>>

OBJECTIVE 14a.15:

Name and locate the components of the sludge dewatering unit listed on page 17. Name and select reference materials which explain the normal operation procedures, the purpose of each component, how the component works and why it is important.

CONDITIONS:

Given a sludge dewatering unit, unit components or a diagram, model or photographs of a unit and reference materials, including:
contractor's plans of the sludge dewatering unit
manufacturer's maintenance guides
operation and maintenance manuals

ACCEPTABLE PERFORMANCE: The student will:

Name and locate the components of the sludge dewatering unit.

Name and select reference materials which explain the normal operation procedures, the purpose of each component, how the component works and why it is important.

INSTRUCTOR ACTIVITY:

1. Point out components of the sludge dewatering unit on diagrams, photographs or models.
2. Listen to the student naming the components and the applicable reference materials during a plant tour.
3. Name and display the reference materials which describe the sludge dewatering unit and normal operation procedures.

STUDENT ACTIVITY:

1. Name the components which the instructor points out on diagrams, photographs or models.
2. Name the components which the instructor points out during a plant tour and name the reference materials which apply to the components.
3. Name and select the reference materials which describe the sludge dewatering unit and normal operation procedures.

<<<<<<>>>>>>

OBJECTIVE 14a.16: *Perform the abnormal operation procedures for the sludge dewatering unit.*

CONDITIONS: Given a wastestream in a treatment plant and reference materials, including:

industrial waste records
operation logs
operator manuals
plant performance guides

ACCEPTABLE PERFORMANCE: The student will:

Evaluate the wastestream for abnormal conditions, commenting on:

alkalinity	level
filterability	pH
flow	sludge density

Select the references he needs to return the wastestream to normal.

Perform the abnormal operation procedures.

INSTRUCTOR ACTIVITY:

1. Observe the student as he evaluates the wastestream in a treatment plant.
2. Describe the references needed to correct abnormal conditions of the wastestream.
3. Observe the student performing the abnormal operation procedures in simulated situations and in a treatment plant.

STUDENT ACTIVITY:

1. Evaluate the wastestream in a treatment plant.
2. Select the references needed to correct abnormal conditions of the wastestream.
3. Perform the abnormal operation procedures in simulated situations or in a treatment plant.

<<<<<<>>>>>>

MODULE 14B

SLUDGE DEWATERING

A continuous feed centrifuge unit

Composite Model Plant Unit O

PURPOSE: *In this module the student will learn to perform all the activities in the objectives as they apply to a continuous feed centrifuge unit. READ PAGES 1 TO 11 BEFORE USING THIS MODULE.*

OBJECTIVES:

- *14b.1* *Identify the sludge dewatering unit.*
- *14b.2* *Describe the sludge dewatering process in technical and non-technical terms.*
- *14b.3* *Describe the safety procedures for the sludge dewatering unit and explain how the procedures protect employees and visitors.*
- *14b.4* *Identify the components of a sludge dewatering unit. Explain the purpose of each component, how the component works and why it is important.*
- *14b.5* *Describe the normal operation procedures for the sludge dewatering unit components listed on page 34.*
- *14b.6* *Perform the normal operation procedures for the sludge dewatering unit.*
- *14b.7* *Describe and perform the start-up and shut-down procedures for the sludge dewatering unit.*
- *14b.8* *Describe the abnormal operation procedures for the sludge dewatering process.*
- *14b.9* *Describe the preventive maintenance procedures for the sludge dewatering unit.*
- *14b.10* *Perform the preventive maintenance procedures for the sludge dewatering unit.*
- *14b.11* *Describe the corrective maintenance procedures for the sludge dewatering unit components listed on page 34.*
- *14b.12* *Perform the corrective maintenance procedures for the sludge dewatering unit components.*
- *14b.13* *Perform the safety procedures for the sludge dewatering unit and demonstrate how they protect employees and visitors.*
- *14b.14* *Compare other sludge dewatering units to the continuous feed centrifuge unit (composite model plant unit O).*
- *14b.15* *Name and locate the components of the sludge dewatering unit listed on page 34. Name and select reference materials which explain the normal operation procedures, the purpose of each component, how the component works and why it is important.*

14b.16 Perform the abnormal operation procedures for the sludge dewatering unit.

RESOURCES: 3 116 120 125 141 143 144 307 308 309 316
317 320 321 324 421 459 511 551 552 553 554
937 990 1033 1034 1399

<<<<<<>>>>>>

OBJECTIVE 14b.1: *Identify the sludge dewatering unit.*

CONDITIONS: Given a unit, a model of a unit or a photograph of a unit.

ACCEPTABLE PERFORMANCE: The student will:

Indicate whether the process unit is used for sludge dewatering.

INSTRUCTOR ACTIVITY:

1. Point out characteristics which distinguish the sludge dewatering unit from other process units.

STUDENT ACTIVITY:

1. Develop a picture file of sludge dewatering units. Mark distinguishing characteristics.

<<<<<<>>>>>>

OBJECTIVE 14b.2: *Describe the sludge dewatering process in technical and nontechnical terms.*

CONDITIONS: Given photographs of the sludge dewatering unit.

ACCEPTABLE PERFORMANCE: The student will:

Describe the sludge dewatering unit.

Describe the purpose of sludge dewatering.

Describe how sludge dewatering affects:
solids disposal
pumping and piping
effluent disposal

INSTRUCTOR ACTIVITY:

1. Use diagrams, photographs and slides to describe sludge dewatering.
2. Describe the sludge dewatering process during a plant tour. React to the student's description of the process.

STUDENT ACTIVITY:

1. Describe the sludge dewatering process while viewing photographs, diagrams and slides.
2. Observe and describe the sludge dewatering process during a plant tour.

<<<<<<>>>>>>

OBJECTIVE 14b.3: *Describe the safety procedures for the sludge dewatering unit and explain how the procedures protect employees and visitors.*

CONDITIONS: Given a list of operation and maintenance procedures.

ACCEPTABLE PERFORMANCE: The student will:

Describe the safety procedures for the sludge dewatering unit, commenting on:

- High-risk activities
  - removing debris from channels
  - working with switches in automatic position
- Sources of danger
  - acid wastes
  - caustic wastes
  - chemical slurries
  - deep wells
  - electrical equipment
  - explosive gases
  - moving parts
  - open doors and covers
  - slippery walks
  - toxic gases
  - welding torches
- Safety equipment
  - belt guards
  - ear plugs
  - fire-fighting equipment
  - first-aid kit
  - lockout tags and keys
  - proper lighting

Safety equipment (continued)
- protective clothing
- railings
- stair safety treads
- ventilation system

Explain how the procedures protect employees and visitors.

INSTRUCTOR ACTIVITY:

1. Discuss treatment plant case histories.
2. Describe the conditions in a plant and ask for evaluation.
3. Describe the safety procedures for each operation and maintenance procedure.
4. Prepare slides of sources of danger and high-risk activities.

STUDENT ACTIVITY:

1. Read case histories and comment on employee safety procedures.
2. Evaluate conditions which the instructor has described. Suggest remedies.
3. Role play operation or maintenance procedures. Select proper safety equipment and name the sources of danger and high-risk activities. Develop a manual of safety procedures for the sludge dewatering unit.
4. Identify sources of danger and high-risk activities pictured in slides.

<<<<<<>>>>>>

OBJECTIVE 14b.4: *Identify the components of a sludge dewatering unit. Explain the purpose of each component, how the component works and why it is important.*

CONDITIONS: Given a sludge dewatering unit, unit components or a diagram, model or photographs of a unit and a list of components.

ACCEPTABLE PERFORMANCE: The student will:

Identify components of the sludge dewatering unit and associated equipment:

belt conveyor	chemical conditioner
blower	chemical feeder
centrifuge	fire-fighting equipment

first-aid kit	screw conveyor
mixing tank	sludge pump
motor	variable speed drive
pressure gage	

Explain the purpose of each component, how the component works and why it is important.

INSTRUCTOR ACTIVITY:

1. Point out and name components in diagrams, photographs or models.
2. Arrange photographs or models of components in the workshop for student identification.
3. Point out and name components during a plant tour.
4. Question the students about the purpose of each component, how the component works and why it is important.

STUDENT ACTIVITY:

1. Identify the components which the instructor names on diagrams, photographs or models.
2. Identify the components at stations in the workshop in writing.
3. Identify components during a plant tour.
4. Explain the purpose of each component, how the component works and why it is important.

<<<<<<<<<<>>>>>>>>>>

OBJECTIVE 14b.5: *Describe the normal operation procedures for the sludge dewatering unit components listed on page 34.*

CONDITIONS: Given a sludge dewatering unit or slides or photographs of a sludge dewatering unit, a list of components of the unit, a checklist of characteristics and a normal operation procedures manual.

ACCEPTABLE PERFORMANCE: The student will:

Describe the characteristics of each component which the operator checks to determine whether the component is functioning normally, commenting on:

color	pressure
corrosion	sound
flow	temperature
motion	vacuum
odor	vibration
position	

Name the sense or indicator which monitors each characteristic.

Explain how often the characteristics of each component must be checked and why the component must be checked on this schedule.

Describe what an operator does if the characteristics of a component indicate that it is not functioning normally, including:
- making adjustments
- deciding about corrective maintenance
- reporting to supervisors
- reporting in written records

Explain why a component's characteristics must be returned to normal.

Describe routine sampling for the sludge dewatering process.

List routine calculations for the sludge dewatering process.

Describe routine procedures for recording data.

INSTRUCTOR ACTIVITY:

1. Describe the characteristics of the components of the sludge dewatering unit.
2. Describe the normal operation procedures for the sludge dewatering unit. Use color pictures.
3. Describe the normal operation procedures during a slide show of components of the sludge dewatering unit.
4. Describe and explain the normal operation procedures during a plant tour. Listen to the student's description of the procedures.

STUDENT ACTIVITY:

1. Develop a checklist, listing the components of the sludge dewatering unit and their normal characteristics.
2. Develop a manual of normal operation procedures.
3. Describe the normal operation procedures during a slide show of components of the sludge dewatering unit.
4. Observe and describe the normal operation procedures during a plant tour.

<<<<<<>>>>>>

OBJECTIVE 14b.6: *Perform the normal operation procedures for the sludge dewatering unit.*

CONDITIONS: Given a sludge dewatering unit, the manual of normal operation procedures which the student has developed for the sludge dewatering unit and basic references.

ACCEPTABLE PERFORMANCE: The student will:

Check and evaluate the characteristics of each component, explaining his actions.

Perform the procedures which an operator follows if the characteristics of a component indicate that it is not functioning normally.

Perform the routine sampling.

Perform the routine calculations.

Perform the routine record keeping.

INSTRUCTOR ACTIVITY:

1. Observe the student demonstrating normal operation procedures in a dry run in a treatment plant.
2. Observe the student performing normal operation procedures in a treatment plant.

STUDENT ACTIVITY:

1. Demonstrate the normal operation procedures in a dry run in a treatment plant.
2. Perform and explain the normal operation procedures in a treatment plant.

<<<<<<>>>>>>

OBJECTIVE 14b.7: *Describe and perform the start-up and shut-down procedures for the sludge dewatering unit.*

CONDITIONS: Given a mock-up, model or photograph of a sludge dewatering unit and a sludge dewatering unit with the manufacturer's operation manual.

ACCEPTABLE PERFORMANCE: The student will:

Start up and shut down a sludge dewatering unit, following the manufacturer's instructions.

INSTRUCTOR ACTIVITY:

1. Demonstrate and perform the start-up procedures in a treatment plant.
2. Demonstrate and perform the shut-down procedures in a treatment plant.
3. Observe the student performing the start-up procedures in a treatment plant.
4. Observe the student performing the shut-down procedures in a treatment plant.
5. Observe the student as he evaluates his start-up procedures.
6. Observe the student as he evaluates his shut-down procedures.

STUDENT ACTIVITY:

1. Describe the start-up procedures in a dry run in a treatment plant.
2. Describe the shut-down procedures in a dry run in a treatment plant.
3. Perform the start-up procedures in a treatment plant.
4. Perform the shut-down procedures in a treatment plant.
5. Evaluate the operation of the sludge dewatering unit to determine whether correct start-up procedures have been used. Use the normal operation procedures manual which the student has developed. (See objective 1.4.)
6. Evaluate the operation of the sludge dewatering unit to determine whether correct shut-down procedures have been used. Use the normal operation procedures manual which the student has developed. (See objective 1.4.)

<<<<<<>>>>>>

OBJECTIVE 14b.8: *Describe the abnormal operation procedures for the sludge dewatering process.*

CONDITIONS: Given a wastestream in a treatment plant or color photographs of a wastestream, a checklist of the conditions of the wastestream and plant records and reference materials.

ACCEPTABLE PERFORMANCE: The student will:

Evaluate the wastestream for abnormal conditions, commenting on:

alkalinity	level
filterability	pH
flow	sludge density

Describe the cause and effect of the abnormal condition.

Explain how often the condition of the wastestream must be checked.

Describe what an operator does if he observes abnormal conditions, including:
- operational changes
- reporting to supervisors
- sampling procedures

Describe how the actions of the operator will improve the condition of the wastestream.

INSTRUCTOR ACTIVITY:

1. Describe and explain the abnormal conditions of the wastestream illustrated in color pictures.
2. Describe and explain the abnormal operation procedures illustrated in pictures and described in plant records and case histories.
3. Describe and explain the abnormal operation procedures during a slide show.
4. Describe and explain the abnormal operation procedures during a plant tour. Listen to the student's description of the procedures.

STUDENT ACTIVITY:

1. Evaluate and explain the abnormal conditions of the wastestream which are illustrated in color pictures.
2. Describe and explain the abnormal operation procedures illustrated in pictures and described in plant records and case histories.
3. Describe and explain the abnormal operation procedures in a class discussion after a slide show.
4. Evaluate and explain the condition of the wastestream during a plant tour. Describe and explain the abnormal operation procedures.

<<<<<<>>>>>>

OBJECTIVE 14b.9: *Describe the preventive maintenance procedures for the sludge dewatering unit.*

CONDITIONS:

Given a sludge dewatering unit or pictures and drawings of a sludge dewatering unit and reference materials, including:

- inspection records
- manufacturer's maintenance guides
- plant drawings and specifications
- preventive maintenance schedule

ACCEPTABLE PERFORMANCE:

The student will:

Describe these preventive maintenance procedures for the sludge dewatering unit:

- Cleaning
  - belt conveyor
  - blower
  - centrifuge
  - chemical conditioner
  - chemical feeder
  - motor
  - screw conveyor
  - sludge pump
  - variable speed drive
- Lubrication
  - belt conveyor
  - blower
  - centrifuge
  - chemical conditioner
  - chemical feeder
  - motor
  - screw conveyor
  - sludge pump
  - variable speed drive
- Mechanical adjustment
  - belt conveyor
  - blower
  - centrifuge
  - chemical conditioner
  - chemical feeder
  - motor
  - pressure gage
  - screw conveyor
  - sludge pump
  - variable speed drive
- Painting
  - blower
  - centrifuge
  - chemical conditioner
  - chemical feeder
  - mixing tank
  - motor
  - screw conveyor
  - sludge pump
  - variable speed drive
- Replacement
  - fire-fighting equipment
  - first-aid kit
- Wear measurement
  - belt conveyor
  - centrifuge

Name the reference materials and tools needed to perform the preventive maintenance procedures.

Explain how often each preventive maintenance procedure must be performed.

Explain how an operator determines whether a component needs preventive maintenance.

Describe what an operator does if a component needs preventive maintenance.

Explain why each preventive maintenance procedure is important.

INSTRUCTOR ACTIVITY:

1. Describe and explain the preventive maintenance procedures for the sludge dewatering unit.
2. Describe and explain the preventive maintenance procedures during a slide show.
3. Describe and explain the preventive maintenance procedures during a plant tour.

STUDENT ACTIVITY:

1. Develop a preventive maintenance schedule and a manual of preventive maintenance procedures.
2. Observe, describe and explain the preventive maintenance procedures during a slide show.
3. Observe, describe and explain the preventive maintenance procedures during a plant tour.

<<<<<<>>>>>>

OBJECTIVE 14b.10: *Perform the preventive maintenance procedures for the sludge dewatering unit.*

CONDITIONS: Given a sludge dewatering unit and tools and reference materials, including:

inspection records
manufacturer's maintenance guides
plant drawings and specifications
preventive maintenance schedule

ACCEPTABLE PERFORMANCE: The student will:

Select the reference materials and tools needed to perform the preventive maintenance procedures.

Apply the preventive maintenance schedule for the sludge dewatering unit, explaining his actions.

Perform the procedures which an operator follows when a component needs preventive maintenance, explaining his actions.

INSTRUCTOR ACTIVITY:

1. Set up simulated situations in the workshop.
2. Observe student inspection of a treatment plant.
3. Observe the student performing the preventive maintenance procedures in a treatment plant.

STUDENT ACTIVITY:

1. Small groups of students perform the preventive maintenance procedures in simulated situations in the workshop.
2. Inspect a treatment plant. Evaluate and explain the preventive maintenance procedures.
3. Perform and explain the preventive maintenance procedures in a treatment plant.

<<<<<<>>>>>>

OBJECTIVE 14b.11: *Describe the corrective maintenance procedures for the sludge dewatering unit components listed on page 34.*

CONDITIONS:

Given a sludge dewatering unit or a mock-up, photographs or drawings of a sludge dewatering unit, the manual of operation procedures which the student has developed for the sludge dewatering unit, tools and reference materials, including:

- catalogue of replacement parts
- equipment catalogues
- manufacturer's maintenance guides

ACCEPTABLE PERFORMANCE:

The student will:

Describe how an operator evaluates each component of the sludge dewatering unit for corrective maintenance, commenting on:

- color
- corrosion
- flow
- motion
- odor
- position
- pressure
- sound
- temperature
- vacuum
- vibration

Explain why a component has malfunctioned.

Name the reference materials and tools needed to perform the corrective maintenance.

Describe what an operator does when he discovers a malfunction, including:

- evaluation of capabilities of plant personnel to perform the procedures
- selection of replacement parts
- record keeping

Describe how the operator corrects the malfunction.

INSTRUCTOR ACTIVITY:

1. Describe and explain the corrective maintenance procedures for the sludge dewatering unit, using diagrams and pictures.
2. Describe and explain the corrective maintenance procedures during a slide show.
3. Describe and explain the corrective maintenance procedures during treatment plant tours.

STUDENT ACTIVITY:

1. Describe and explain the corrective maintenance procedures in situations described or pictured by the instructor.
2. Describe and explain the corrective maintenance procedures during a slide show.
3. Observe, describe and explain the corrective maintenance procedures during a treatment plant tour.

<<<<<<<<<<<

OBJECTIVE 14b.12: *Perform the corrective maintenance procedures for the sludge dewatering unit components.*

CONDITIONS: Given a sludge dewatering unit or unit components, the operation procedures manual which the student has developed, tools and reference materials, including:

- catalogue of replacement parts
- equipment catalogues
- manufacturer's maintenance guides
- manufacturer's operation manual

ACCEPTABLE PERFORMANCE: The student will:

Evaluate the components of the sludge dewatering unit for corrective maintenance, explaining why a component has malfunctioned and commenting on:

color	pressure
corrosion	sound
flow	temperature
motion	vacuum
odor	vibration
position	

Select the reference materials and tools needed to perform the corrective maintenance.

Perform the procedures which an operator follows when a component malfunctions, including:
- evaluation of capabilities of plant personnel to perform the procedures
- selection of replacement parts
- record keeping

Correct the malfunction.

INSTRUCTOR ACTIVITY:

1. Set up simulated situations in the workshop.
2. Observe the student as he evaluates the components in a treatment plant.
3. Observe the student performing the corrective maintenance procedures in a treatment plant.

STUDENT ACTIVITY:

1. Small groups of students perform and explain the corrective maintenance procedures in simulated situations in the workshop.
2. Evaluate the components for corrective maintenance.
3. Perform and explain the corrective maintenance procedures in a treatment plant.

<<<<<<>>>>>>

OBJECTIVE 14b.13: *Perform the safety procedures for the sludge dewatering unit and demonstrate how they protect employees and visitors.*

CONDITIONS: Given a list of operation or maintenance procedures, the student's manual of safety procedures, tools and safety equipment.

ACCEPTABLE PERFORMANCE: The student will:

Identify hazardous conditions in the sludge dewatering unit, commenting on:
- high-risk activities
- sources of danger
- safety equipment

Explain how the procedures protect employees and visitors.

Recommend corrective procedures and correct the unsafe condition.

INSTRUCTOR ACTIVITY:

1. Set up simulated situations in the workshop.
2. Observe the student as he evaluates the safety conditions in a treatment plant.
3. Observe the student performing the safety procedures in a treatment plant.

STUDENT ACTIVITY:

1. Evaluate safety conditions in simulated situations and recommend corrective procedures.
2. Evaluate safety conditions in a treatment plant and recommend corrective procedures.
3. Perform the safety procedures in a treatment plant.

<<<<<<>>>>>>

OBJECTIVE 14b.14: *Compare other sludge dewatering units to the continuous feed centrifuge unit (composite model plant unit 0).*

CONDITIONS: Given a process unit and reference materials, including:

equipment catalogues
laboratory reports
manufacturer's bulletins
manufacturer's operation manuals
plant maintenance and operation records

ACCEPTABLE PERFORMANCE: The student will:

Compare composite model plant unit 0 with:
a vacuum filter unit with cloth.
a vacuum filter unit with coil.

Consider:
availability of replacement parts
capital costs
dependency on surrounding environment
ease of repair
efficiency
flow-handling capabilities
maintenance costs
nuisance to neighbors
operational costs
operational skills
personnel requirements
reliability
resistance to upset
sensitivity of controls
space requirements
waste-handling capabilities

INSTRUCTOR ACTIVITY:

1. Prepare a chart for tabulation of information about the units.
2. Compare composite model plant unit 0 with the other units.
3. Help the student to collect information for reports on the advantages and disadvantages of each unit.

STUDENT ACTIVITY:

1. List information about the units on a chart.
2. Compare the units in a panel discussion.
3. Write a report on the advantages and disadvantages of each unit.

<<<<<<>>>>>>

OBJECTIVE 14b.15:

Name and locate the components of the sludge dewatering unit listed on page 34. Name and select reference materials which explain the normal operation procedures, the purpose of each component, how the component works and why it is important.

CONDITIONS:

Given a sludge dewatering unit, unit components or a diagram, model or photographs of a unit and reference materials, including:

contractor's plans of the sludge dewatering unit
manufacturer's maintenance guides
operation and maintenance manuals

ACCEPTABLE PERFORMANCE:

The student will:

Name and locate the components of the sludge dewatering unit.

Name and select reference materials which explain the normal operation procedures, the purpose of each component, how the component works and why it is important.

INSTRUCTOR ACTIVITY:

1. Point out components of the sludge dewatering unit on diagrams, photographs or models.
2. Listen to the student naming the components and the applicable reference materials during a plant tour.
3. Name and display the reference materials which describe the sludge dewatering unit and normal operation procedures.

STUDENT ACTIVITY:

1. Name the components which the instructor points out on diagrams, photographs or models.
2. Name the components which the instructor points out during a plant tour and name the reference materials which apply to the components.
3. Name and select the reference materials which describe the sludge dewatering unit and normal operation procedures.

<<<<<<<>>>>>>>

OBJECTIVE 14b.16: *Perform the abnormal operation procedures for the sludge dewatering unit.*

CONDITIONS: Given a wastestream in a treatment plant and reference materials, including:

industrial waste records
operation logs
operator manuals
plant performance guides

ACCEPTABLE PERFORMANCE: The student will:

Evaluate the wastestream for abnormal conditions, commenting on:

alkalinity	level
filterability	pH
flow	sludge density

Select the references he needs to return the wastestream to normal.

Perform the abnormal operation procedures.

INSTRUCTOR ACTIVITY:

1. Observe the student as he evaluates the wastestream in a treatment plant.
2. Describe the references needed to correct abnormal conditions of the wastestream.
3. Observe the student performing the abnormal operation procedures in simulated situations and in a treatment plant.

STUDENT ACTIVITY:

1. Evaluate the wastestream in a treatment plant.
2. Select the references needed to correct abnormal conditions of the wastestream.
3. Perform the abnormal operation procedures in simulated situations or in a treatment plant.

<<<<<<<>>>>>>>

MODULE 15

SOLIDS DISPOSAL

A multiple hearth incinerator unit

Composite Model Plant Unit P

PURPOSE: *In this module the student will learn to perform all the activities in the objectives as they apply to a multiple hearth incinerator unit. READ PAGES 1 TO 11 BEFORE USING THIS MODULE.*

OBJECTIVES:

15.1 *Identify the solids disposal unit.*

15.2 *Describe the solids disposal process in technical and nontechnical terms.*

15.3 *Describe the safety procedures for the solids disposal unit and explain how the procedures protect employees and visitors.*

15.4 *Identify the components of a solids disposal unit. Explain the purpose of each component, how the component works and why it is important.*

15.5 *Describe the normal operation procedures for the solids disposal unit components listed on page 53.*

15.6 *Perform the normal operation procedures for the solids disposal unit.*

15.7 *Describe and perform the start-up and shut-down procedures for the solids disposal unit.*

15.8 *Describe the abnormal operation procedures for the solids disposal process.*

15.9 *Describe the preventive maintenance procedures for the solids disposal unit.*

15.10 *Perform the preventive maintenance procedures for the solids disposal unit.*

15.11 *Describe the corrective maintenance procedures for the solids disposal unit components listed on page 53.*

15.12 *Perform the corrective maintenance procedures for the solids disposal unit components.*

15.13 *Perform the safety procedures for the solids disposal unit and demonstrate how they protect employees and visitors.*

15.14 *Compare other solids disposal units to the multiple hearth incinerator unit (composite model plant unit P).*

15.15 *Name and locate the components of the solids disposal unit listed on page 53. Name and select reference materials which explain the normal operation procedures, the purpose of each component, how the component works and why it is important.*

15.16 Perform the abnormal operation procedures for the solids disposal unit.

RESOURCES: 3 116 120 125 141 143 144 307 308 309 316
317 320 321 324 421 459 511 549 551 552 553
554 937 990 1033 1034 1399

<<<<<<<<<<<

OBJECTIVE 15.1: *Identify the solids disposal unit.*

CONDITIONS: Given a unit, a model of a unit or a photograph of a unit.

ACCEPTABLE PERFORMANCE: The student will:

Indicate whether the process unit is used for solids disposal.

INSTRUCTOR ACTIVITY:

1. Point out characteristics which distinguish the solids disposal unit from other process units.

STUDENT ACTIVITY:

1. Develop a picture file of solids disposal units. Mark distinguishing characteristics.

<<<<<<<<<<<

OBJECTIVE 15.2: *Describe the solids disposal process in technical and nontechnical terms.*

CONDITIONS: Given photographs of the solids disposal unit.

ACCEPTABLE PERFORMANCE: The student will:

Describe the solids disposal unit, explaining the meaning of:
combustion chamber
furnace

Describe the purpose of solids disposal.

Describe how solids disposal affects pumping and piping.

INSTRUCTOR ACTIVITY:

1. Use diagrams, photographs and slides to describe solids disposal.
2. Describe the solids disposal process during a plant tour. React to the student's description of the process.

STUDENT ACTIVITY:

1. Describe the solids disposal process while viewing photographs, diagrams and slides.
2. Observe and describe the solids disposal process during a plant tour.

<<<<<<>>>>>>

OBJECTIVE 15.3: *Describe the safety procedures for the solids disposal unit and explain how the procedures protect employees and visitors.*

CONDITIONS: Given a list of operation and maintenance procedures.

ACCEPTABLE PERFORMANCE: The student will:

Describe the safety procedures for the solids disposal unit, commenting on:

- High-risk activities
  - handling hot materials
  - removing debris from channels
  - working with switches in automatic position
- Sources of danger
  - acid wastes
  - caustic wastes
  - deep wells
  - electrical equipment
  - explosive gases
  - flammable paint
  - heated parts
  - hot ash
  - moving parts
  - open doors and covers
  - slippery walks
  - toxic gases

Safety equipment
- electrical lockout tags and keys
- fire-fighting equipment
- first-aid kit
- protective clothing
- railings
- safety glasses
- stair safety treads

Explain how the procedures protect employees and visitors.

INSTRUCTOR ACTIVITY:

1. Discuss treatment plant case histories.
2. Describe the conditions in a plant and ask for evaluation.
3. Describe the safety procedures for each operation and maintenance procedure.
4. Prepare slides of sources of danger and high-risk activities.

STUDENT ACTIVITY:

1. Read case histories and comment on employee safety procedures.
2. Evaluate conditions which the instructor has described. Suggest remedies.
3. Role play operation or maintenance procedures. Select proper safety equipment and name the sources of danger and high-risk activities. Develop a manual of safety procedures for the solids disposal unit.
4. Identify sources of danger and high-risk activities.

<<<<<<>>>>>>

OBJECTIVE 15.4: *Identify the components of a solids disposal unit. Explain the purpose of each component, how the component works and why it is important.*

CONDITIONS: Given a solids disposal unit, unit components or a diagram, model or photographs of a unit and a list of components.

ACCEPTABLE PERFORMANCE: The student will:

Identify components of the solids disposal unit and associated equipment:

ash hopper	motor
ash pump	plow
bearing	rabble arm
bubble control	rake
chain	rake-cleaner
conveyor belt	rake drive motor
drive belt	roller
fan	screen
fire-fighting equipment	scrubber
first-aid kit	sprocket
gear	switchgear
grinder	water valve

Explain the purpose of each component, how the component works and why it is important.

INSTRUCTOR ACTIVITY:

1. Point out and name components in diagrams, photographs or models.
2. Arrange photographs or models of components in the workshop for student identification.
3. Point out and name components during a plant tour.
4. Question the students about the purpose of each component, how the component works and why it is important.

STUDENT ACTIVITY:

1. Identify the components which the instructor names on diagrams, photographs or models.
2. Identify the components at stations in the workshop in writing.
3. Identify components during a plant tour.
4. Explain the purpose of each component, how the component works and why it is important.

<<<<<<>>>>>>

OBJECTIVE 15.5: *Describe the normal operation procedures for the solids disposal unit components listed above.*

CONDITIONS: Given a solids disposal unit or slides or photographs of a solids disposal unit, a list of components of the unit, a checklist of characteristics and a normal operation procedures manual.

ACCEPTABLE PERFORMANCE: The student will:

Describe the characteristics of each component which the operator checks to determine whether the component is functioning normally, commenting on:

- color
- corrosion
- motion
- odor
- position
- pressure
- sound
- temperature
- vibration

Name the sense or indicator which monitors each characteristic.

Explain how often the characteristics of each component must be checked and why the component must be checked on this schedule.

Describe what an operator does if the characteristics of a component indicate that it is not functioning normally, including:

- making adjustments
- deciding about corrective maintenance
- reporting to supervisors
- reporting in written records

Explain why a component's characteristics must be returned to normal.

Describe routine sampling for the solids disposal process.

List routine calculations for the solids disposal process.

Describe routine procedures for recording data.

INSTRUCTOR ACTIVITY:

1. Describe the characteristics of the components of the solids disposal unit.
2. Describe the normal operation procedures for the solids disposal unit. Use color pictures.
3. Describe the normal operation procedures during a slide show of components of the solids disposal unit.
4. Describe and explain the normal operation procedures during a plant tour. Listen to the student's description of the procedures.

STUDENT ACTIVITY:

1. Develop a checklist, listing the components of the solids disposal unit and their normal characteristics.
2. Develop a manual of normal operation procedures.

3. Describe the normal operation procedures during a slide show of components of the solids disposal unit.
4. Observe and describe the normal operation procedures during a plant tour.

<<<<<<>>>>>>

OBJECTIVE 15.6: *Perform the normal operation procedures for the solids disposal unit.*

CONDITIONS: Given a solids disposal unit, the manual of normal operation procedures which the student has developed for the solids disposal unit and basic references.

ACCEPTABLE PERFORMANCE: The student will:

Check and evaluate the characteristics of each component, explaining his actions.

Perform the procedures which an operator follows if the characteristics of a component indicate that it is not functioning normally.

Perform the routine sampling.

Perform the routine calculations.

Perform the routine record keeping.

INSTRUCTOR ACTIVITY:

1. Observe the student demonstrating normal operation procedures in a dry run in a treatment plant.
2. Observe the student performing normal operation procedures in a treatment plant.

STUDENT ACTIVITY:

1. Demonstrate the normal operation procedures in a dry run in a treatment plant.
2. Perform and explain the normal operation procedures in a treatment plant.

<<<<<<>>>>>>

OBJECTIVE 15.7: *Describe and perform the start-up and shut-down procedures for the solids disposal unit.*

CONDITIONS: Given a mock-up, model or photograph of a solids disposal unit and a solids disposal unit with the manufacturer's operation manual.

ACCEPTABLE PERFORMANCE: The student will:

Start up and shut down a solids disposal unit, following the manufacturer's instructions.

INSTRUCTOR ACTIVITY:

1. Demonstrate and perform the start-up procedures in a treatment plant.
2. Demonstrate and perform the shut-down procedures in a treatment plant.
3. Observe the student performing the start-up procedures in a treatment plant.
4. Observe the student performing the shut-down procedures in a treatment plant.
5. Observe the student as he evaluates his start-up procedures.
6. Observe the student as he evaluates his shut-down procedures.

STUDENT ACTIVITY:

1. Describe the start-up procedures in a dry run in a treatment plant.
2. Describe the shut-down procedures in a dry run in a treatment plant.
3. Perform the start-up procedures in a treatment plant.
4. Perform the shut-down procedures in a treatment plant.
5. Evaluate the operation of the solids disposal unit to determine whether correct start-up procedures have been used. Use the normal operation procedures manual which the student has developed. (See objective 1.4.)
6. Evaluate the operation of the solids disposal unit to determine whether correct shut-down procedures have been used. Use the normal operation procedures manual which the student has developed. (See objective 1.4.)

<<<<<<>>>>>>

OBJECTIVE 15.8: *Describe the abnormal operation procedures for the solids disposal process.*

CONDITIONS:

Given a wastestream in a treatment plant or color photographs of a wastestream, a checklist of the conditions of the wastestream and plant records and reference materials.

ACCEPTABLE PERFORMANCE:

The student will:

Evaluate the wastestream for abnormal conditions, commenting on:

- flow
- temperature
- moisture content
- volatile content
- odor

Describe the cause and effect of the abnormal condition.

Explain how often the condition of the wastestream must be checked.

Describe what an operator does if he observes abnormal conditions, including:

- operational changes
- reporting to supervisors
- sampling procedures

Describe how the actions of the operator will improve the condition of the wastestream.

INSTRUCTOR ACTIVITY:

1. Describe and explain the abnormal conditions of the wastestream illustrated in color pictures.
2. Describe and explain the abnormal operation procedures illustrated in pictures and described in plant records and case histories.
3. Describe and explain the abnormal operation procedures during a slide show.
4. Describe and explain the abnormal operation procedures during a plant tour. Listen to the student's description of the procedures.

STUDENT ACTIVITY:

1. Evaluate and explain the abnormal conditions of the wastestream which are illustrated in color pictures.
2. Describe and explain the abnormal operation procedures illustrated in pictures and described in plant records and case histories.
3. Describe and explain the abnormal operation procedures in a class discussion after a slide show.
4. Evaluate and explain the condition of the wastestream

during a plant tour. Describe and explain the abnormal operation procedures.

<<<<<<>>>>>>

OBJECTIVE 15.9: *Describe the preventive maintenance procedures for the solids disposal unit.*

CONDITIONS: Given a solids disposal unit or pictures and drawings of a solids disposal unit and reference materials, including:

- inspection records
- manufacturer's maintenance guides
- plant drawings and specifications
- preventive maintenance schedule

ACCEPTABLE PERFORMANCE: The student will:

Describe these preventive maintenance procedures for the solids disposal unit:

- Cleaning
  - ash hopper
  - ash pump
  - conveyor belt
  - fan
  - grinder
  - motor
  - plow
  - rake drive motor
  - screen
  - scrubber
- Lubrication
  - ash pump
  - fan
  - gear
  - grinder
  - motor
  - rake drive motor
  - roller
  - scrubber
  - sprocket
- Mechanical adjustment
  - ash pump
  - bearing
  - bubble control
  - chain
  - conveyor belt
  - drive belt
  - fan
  - gear
  - grinder
  - motor
  - plow
  - rabble arm
  - rake
  - rake-cleaner
  - rake drive motor
  - roller
  - screen
  - scrubber
  - sprocket
  - switchgear
  - water valve
- Painting
  - ash hopper
  - ash pump
  - fan
  - motor
  - rake drive motor
- Replacement
  - fire-fighting equipment
  - first-aid kit

Wear measurement
- bearing
- chain
- conveyor belt
- drive belt
- gear
- grinder
- plow
- rabble arm
- rake
- rake cleaner
- roller
- sprocket

Name the reference materials and tools needed to perform the preventive maintenance procedures.

Explain how often each preventive maintenance procedure must be performed.

Explain how an operator determines whether a component needs preventive maintenance.

Describe what an operator does if a component needs preventive maintenance.

Explain why each preventive maintenance procedure is important.

INSTRUCTOR ACTIVITY:

1. Describe and explain the preventive maintenance procedures for the solids disposal unit.
2. Describe and explain the preventive maintenance procedures during a slide show.
3. Describe and explain the preventive maintenance procedures during a plant tour.

STUDENT ACTIVITY:

1. Develop a preventive maintenance schedule and a manual of preventive maintenance procedures.
2. Observe, describe and explain the preventive maintenance procedures during a slide show.
3. Observe, describe and explain the preventive maintenance procedures during a plant tour.

<<<<<<>>>>>>

OBJECTIVE 15.10: *Perform the preventive maintenance procedures for the solids disposal unit.*

CONDITIONS: Given a solids disposal unit and tools and reference materials, including:
- inspection records
- manufacturer's maintenance guides
- plant drawings and specifications
- preventive maintenance schedule

ACCEPTABLE PERFORMANCE: The student will:

Select the reference materials and tools needed to perform the preventive maintenance procedures.

Apply the preventive maintenance schedule for the solids disposal unit, explaining his actions.

Perform the procedures which an operator follows when a component needs preventive maintenance, explaining his actions.

INSTRUCTOR ACTIVITY:

1. Set up simulated situations in the workshop.
2. Observe student inspection of a treatment plant.
3. Observe the student performing the preventive maintenance procedures in a treatment plant.

STUDENT ACTIVITY:

1. Small groups of students perform the preventive maintenance procedures in simulated situations in the workshop.
2. Inspect a treatment plant. Evaluate and explain the preventive maintenance procedures.
3. Perform and explain the preventive maintenance procedures in a treatment plant.

<<<<<<>>>>>>

OBJECTIVE 15.11: *Describe the corrective maintenance procedures for the solids disposal unit components listed on page 53.*

CONDITIONS: Given a solids disposal unit or a mock-up, photographs or drawings of a solids disposal unit, the manual of operation procedures which the student has developed for the solids disposal unit, tools and reference materials, including:

catalogue of replacement parts
equipment catalogues
manufacturer's maintenance guides

ACCEPTABLE PERFORMANCE: The student will:

Describe how an operator evaluates each component of the solids disposal unit for corrective maintenance, commenting on:

color	motion
corrosion	odor

position
pressure
sound
temperature
vibration

Explain why a component has malfunctioned.

Name the reference materials and tools needed to perform the corrective maintenance.

Describe what an operator does when he discovers a malfunction, including:
evaluation of capabilities of plant personnel to perform the procedures
selection of replacement parts
record keeping

Describe how the operator corrects the malfunction.

INSTRUCTOR ACTIVITY:

1. Describe and explain the corrective maintenance procedures for the solids disposal unit, using diagrams and pictures.
2. Describe and explain the corrective maintenance procedures during a slide show.
3. Describe and explain the corrective maintenance procedures during treatment plant tours.

STUDENT ACTIVITY:

1. Describe and explain the corrective maintenance procedures in situations described or pictured by the instructor.
2. Describe and explain the corrective maintenance procedures during a slide show.
3. Observe, describe and explain the corrective maintenance procedures during a treatment plant tour.

<<<<<<>>>>>>

OBJECTIVE 15.12: *Perform the corrective maintenance procedures for the solids disposal unit components.*

CONDITIONS: Given a solids disposal unit or unit components, the operation procedures manual which the student has developed, tools and reference materials, including:
catalogue of replacement parts
equipment catalogues
manufacturer's maintenance guides
manufacturer's operation manual

ACCEPTABLE PERFORMANCE: The student will:

Evaluate the components of the solids disposal unit for corrective maintenance, explaining why a component has malfunctioned and commenting on:

- color
- corrosion
- motion
- odor
- position
- pressure
- sound
- temperature
- vibration

Select the reference materials and tools needed to perform the corrective maintenance.

Perform the procedures which an operator follows when a component malfunctions, including:

- evaluation of capabilities of plant personnel to perform the procedures
- selection of replacement parts
- record keeping

Correct the malfunction.

INSTRUCTOR ACTIVITY:

1. Set up simulated situations in the workshop.
2. Observe the student as he evaluates the components in a treatment plant.
3. Observe the student performing the corrective maintenance procedures in a treatment plant.

STUDENT ACTIVITY:

1. Small groups of students perform and explain the corrective maintenance procedures in simulated situations in the workshop.
2. Evaluate the components for corrective maintenance.
3. Perform and explain the corrective maintenance procedures in a treatment plant.

<<<<<<>>>>>>

OBJECTIVE 15.13: *Perform the safety procedures for the solids disposal unit and demonstrate how they protect employees and visitors.*

CONDITIONS: Given a list of operation or maintenance procedures, the student's manual of safety procedures, tools and safety equipment.

ACCEPTABLE PERFORMANCE: The student will:

Identify hazardous conditions in the solids disposal unit, commenting on:
- high-risk activities
- sources of danger
- safety equipment

Explain how the procedures protect employees and visitors.

Recommend corrective procedures and correct the unsafe condition.

INSTRUCTOR ACTIVITY:

1. Set up simulated situations in the workshop.
2. Observe the student as he evaluates the safety conditions in a treatment plant.
3. Observe the student performing the safety procedures in a treatment plant.

STUDENT ACTIVITY:

1. Evaluate safety conditions in simulated situations and recommend corrective procedures.
2. Evaluate safety conditions in a treatment plant and recommend corrective procedures.
3. Perform the safety procedures in a treatment plant.

<<<<<<>>>>>>

OBJECTIVE 15.14: *Compare other solids disposal units to the multiple hearth incinerator unit (composite model plant unit P).*

CONDITIONS: Given a process unit and reference materials, including:
- equipment catalogues
- laboratory reports
- manufacturer's bulletins
- manufacturer's operation manuals
- plant maintenance and operation records

ACCEPTABLE PERFORMANCE: The student will:

Compare composite model plant unit P with:
- a fluidized bed incinerator unit.

Consider:
- availability of replacement parts
- capital costs

dependency on surrounding environment
ease of repair
efficiency
flow-handling capabilities
maintenance costs
nuisance to neighbors
operational costs
operational skills
personnel requirements
reliability
resistance to upset
sensitivity of controls
space requirements
waste-handling capabilities

INSTRUCTOR ACTIVITY:

1. Prepare a chart for tabulation of information about the units.
2. Compare composite model plant unit P with the other units.
3. Help the student to collect information for reports on the advantages and disadvantages of each unit.

STUDENT ACTIVITY:

1. List information about the units on a chart.
2. Compare the units in a panel discussion.
3. Write a report on the advantages and disadvantages of each unit.

<<<<<<>>>>>>

OBJECTIVE 15.15:

Name and locate the components of the solids disposal unit listed on page 53. Name and select reference materials which explain the normal operation procedures, the purpose of each component, how the component works and why it is important.

CONDITIONS:

Given a solids disposal unit, unit components or a diagram, model or photographs of a unit and reference materials, including:

contractor's plans of the solids disposal unit
manufacturer's maintenance guides
operation and maintenance manuals

ACCEPTABLE PERFORMANCE: The student will:

Name and locate the components of the solids disposal unit.

Name and select reference materials which explain the normal operation procedures, the purpose of each component, how the component works and why it is important.

INSTRUCTOR ACTIVITY:

1. Point out components of the solids disposal unit on diagrams, photographs or models.
2. Listen to the student naming the components and the applicable reference materials during a plant tour.
3. Name and display the reference materials which describe the solids disposal unit and normal operation procedures.

STUDENT ACTIVITY:

1. Name the components which the instructor points out on diagrams, photographs or models.
2. Name the components which the instructor points out during a plant tour and name the reference materials which apply to the components.
3. Name and select the reference materials which describe the solids disposal unit and normal operation procedures.

<<<<<<>>>>>>

OBJECTIVE 15.16: *Perform the abnormal operation procedures for the solids disposal unit.*

CONDITIONS: Given a wastestream in a treatment plant and reference materials, including:

industrial waste records
operation logs
operator manuals
plant performance guides

ACCEPTABLE PERFORMANCE: The student will:

Evaluate the wastestream for abnormal conditions, commenting on:

flow	temperature
moisture content	volatile content
odor	

Select the references he needs to return the wastestream to normal.

Perform the abnormal operation procedures.

INSTRUCTOR ACTIVITY:

1. Observe the student as he evaluates the wastestream in a treatment plant.
2. Describe the references needed to correct abnormal conditions of the wastestream.
3. Observe the student performing the abnormal operation procedures in simulated situations and in a treatment plant.

STUDENT ACTIVITY:

1. Evaluate the wastestream in a treatment plant.
2. Select the references needed to correct abnormal conditions of the wastestream.
3. Perform the abnormal operation procedures in simulated situations or in a treatment plant.

<<<<<<>>>>>>

MODULE 16

EFFLUENT DISPOSAL

A direct reuse system

Composite Model Plant Unit Q

PURPOSE: *In this module the student will learn to perform all the activities in the objectives as they apply to a direct reuse system. READ PAGES 1 TO 11 BEFORE USING THIS MODULE.*

OBJECTIVES:

16.1 *Identify the effluent disposal unit.*

16.2 *Describe the effluent disposal process in technical and non-technical terms.*

16.3 *Describe the safety procedures for the effluent disposal unit and explain how the procedures protect employees and visitors.*

16.4 *Identify the components of an effluent disposal unit. Explain the purpose of each component, how the component works and why it is important.*

16.5 *Describe the normal operation procedures for the effluent disposal unit components listed on page 71.*

16.6 *Perform the normal operation procedures for the effluent disposal unit.*

16.7 *Describe and perform the start-up and shut-down procedures for the effluent disposal unit.*

16.8 *Describe the abnormal operation procedures for the effluent disposal process.*

16.9 *Describe the preventive maintenance procedures for the effluent disposal unit.*

16.10 *Perform the preventive maintenance procedures for the effluent disposal unit.*

16.11 *Describe the corrective maintenance procedures for the effluent disposal unit components listed on page 71.*

16.12 *Perform the corrective maintenance procedures for the effluent disposal unit components.*

16.13 *Perform the safety procedures for the effluent disposal unit and demonstrate how they protect employees and visitors.*

16.14 *Compare other effluent disposal units to the direct reuse system (composite model plant unit Q).*

16.15 *Name and locate the components of the effluent disposal unit listed on page 71. Name and select reference materials which explain the normal operation procedures, the purpose of each component, how the component works and why it is important.*

16.16 *Perform the abnormal operation procedures for the effluent disposal unit.*

RESOURCES: 3 116 120 125 141 143 144 307 308 309 316 317 320 321 324 421 459 511 549 551 552 553 554 937 990 1033 1034 1399

<<<<<<<<<<<

OBJECTIVE 16.1: *Identify the effluent disposal unit.*

CONDITIONS: Given a unit, a model of a unit or a photograph of a unit.

ACCEPTABLE PERFORMANCE: The student will:

Indicate whether the process unit is used for effluent disposal.

INSTRUCTOR ACTIVITY:

1. Point out characteristics which distinguish the effluent disposal unit from other process units.

STUDENT ACTIVITY:

1. Develop a picture file of effluent disposal units. Mark distinguishing characteristics.

<<<<<<<<<<<

OBJECTIVE 16.2: *Describe the effluent disposal process in technical and nontechnical terms.*

CONDITIONS: Given photographs of the effluent disposal unit.

ACCEPTABLE PERFORMANCE: The student will:

Describe the effluent disposal unit, explaining the quality of treatment required for:
- industrial use
- process water
- recreational use

Describe the purpose of effluent disposal.

Describe how effluent disposal affects:
- prechlorination
- screening and grinding
- grit removal

primary sedimentation
trickling filtration
aeration
secondary sedimentation
pond stabilization
thickening
first stage digestion
second stage digestion
sludge conditioning
post-chlorination
sludge dewatering

INSTRUCTOR ACTIVITY:

1. Use diagrams, photographs and slides to describe effluent disposal.
2. Describe the effluent disposal process during a plant tour. React to the student's description of the process.

STUDENT ACTIVITY:

1. Describe the effluent disposal process while viewing photographs, diagrams and slides.
2. Observe and describe the effluent disposal process during a plant tour.

<<<<<<>>>>>>

OBJECTIVE 16.3: *Describe the safety procedures for the effluent disposal unit and explain how the procedures protect employees and visitors.*

CONDITIONS: Given a list of operation and maintenance procedures.

ACCEPTABLE PERFORMANCE: The student will:

Describe the safety procedures for the effluent disposal unit, commenting on:
- High-risk activities
  - removing debris from channels
  - working with switches in automatic position
- Sources of danger
  - acid wastes
  - caustic wastes
  - deep wells
  - electrical equipment
  - explosive gases

high pressure
moving parts
open channels
open doors and covers
toxic gases
walks

Safety equipment
chains
first-aid kit
harnesses
life preservers
lockout tags and keys
protective clothing
rails
ropes
stair safety treads

Explain how the procedures protect employees and visitors.

INSTRUCTOR ACTIVITY:

1. Discuss treatment plant case histories.
2. Describe the conditions in a plant and ask for evaluation.
3. Describe the safety procedures for each operation and maintenance procedure.
4. Prepare slides of sources of danger and high-risk activities.

STUDENT ACTIVITY:

1. Read case histories and comment on employee safety procedures.
2. Evaluate conditions which the instructor has described. Suggest remedies.
3. Role play operation or maintenance procedures. Select proper safety equipment and name the sources of danger and high-risk activities. Develop a manual of safety procedures for the effluent disposal unit.
4. Identify sources of danger and high-risk activities pictured in slides.

<<<<<<>>>>>>

OBJECTIVE 16.4: *Identify the components of an effluent disposal unit. Explain the purpose of each component, how the component works and why it is important.*

CONDITIONS: Given an effluent disposal unit, unit components or a diagram, model or photographs of a unit and a list of components.

ACCEPTABLE PERFORMANCE: The student will:

Identify components of the effluent disposal unit and associated equipment:

bearing	flow-rate control mechanic
channel	motor
coupling	pipe
filter	pressure control
fire-fighting equipment	pump
first-aid kit	valve

Explain the purpose of each component, how the component works and why it is important.

INSTRUCTOR ACTIVITY:

1. Point out and name components in diagrams, photographs or models.
2. Arrange photographs or models of effluent disposal components in the workshop for student identification.
3. Point out and name components during a plant tour.
4. Question the students about the purpose of each component, how the component works and why it is important.

STUDENT ACTIVITY:

1. Identify the components which the instructor names on diagrams, photographs or models.
2. Identify the components at stations in the workshop in writing.
3. Identify components during a plant tour.
4. Explain the purpose of each component, how the component works and why it is important.

<<<<<<>>>>>>

OBJECTIVE 16.5: *Describe the normal operation procedures for the effluent disposal unit components listed above.*

CONDITIONS: Given an effluent disposal unit or slides or photographs of an effluent disposal unit, a list of components of the unit, a checklist of characteristics and a normal operation procedures manual.

ACCEPTABLE PERFORMANCE: The student will:

Describe the characteristics of each component which the operator checks to determine whether the component is functioning normally, commenting on:

color	position
corrosion	pressure
flow	sound
motion	temperature
odor	vibration

Name the sense or indicator which monitors each characteristic.

Explain how often the characteristics of each component must be checked and why the component must be checked on this schedule.

Describe what an operator does if the characteristics of a component indicate that it is not functioning normally, including:
- making adjustments
- deciding about corrective maintenance
- reporting to supervisors
- reporting in written records

Explain why a component's characteristics must be returned to normal.

Describe routine sampling for the effluent disposal process.

List routine calculations for the effluent disposal process.

Describe routine procedures for recording data.

INSTRUCTOR ACTIVITY:

1. Describe the characteristics of the components of the effluent disposal unit.
2. Describe the normal operation procedures for the effluent disposal unit. Use color pictures.
3. Describe the normal operation procedures during a slide show of components of the effluent disposal unit.
4. Describe and explain the normal operation procedures during a plant tour. Listen to the student's description of the procedures.

STUDENT ACTIVITY:

1. Develop a checklist, listing the components of the effluent disposal unit and their normal characteristics.

2. Develop a manual of normal operation procedures.
3. Describe the normal operation procedures during a slide show of components of the effluent disposal unit.
4. Observe and describe the normal operation procedures during a plant tour.

<<<<<<>>>>>>

OBJECTIVE 16.6: *Perform the normal operation procedures for the effluent disposal unit.*

CONDITIONS: Given an effluent disposal unit, the manual of normal operation procedures which the student has developed for the effluent disposal unit and basic references.

ACCEPTABLE PERFORMANCE: The student will:

Check and evaluate the characteristics of each component, explaining his actions.

Perform the procedures which an operator follows if the characteristics of a component indicate that it is not functioning normally.

Perform the routine sampling.

Perform the routine calculations.

Perform the routine record keeping.

INSTRUCTOR ACTIVITY:

1. Observe the student demonstrating normal operation procedures in a dry run in a treatment plant.
2. Observe the student performing normal operation procedures in a treatment plant.

STUDENT ACTIVITY:

1. Demonstrate the normal operation procedures in a dry run in a treatment plant.
2. Perform and explain the normal operation procedures in a treatment plant.

<<<<<<>>>>>>

OBJECTIVE 16.7: *Describe and perform the start-up and shut-down procedures for the effluent disposal unit.*

CONDITIONS: Given a mock-up, model or photograph of an effluent disposal unit and an effluent disposal unit with the manufacturer's operation manual.

ACCEPTABLE PERFORMANCE: The student will:

Start up and shut down an effluent disposal unit, following the manufacturer's instructions.

INSTRUCTOR ACTIVITY:

1. Demonstrate and perform the start-up procedures in a treatment plant.
2. Demonstrate and perform the shut-down procedures in a treatment plant.
3. Observe the student performing the start-up procedures in a treatment plant.
4. Observe the student performing the shut-down procedures in a treatment plant.
5. Observe the student as he evaluates his start-up procedures.
6. Observe the student as he evaluates his shut-down procedures.

STUDENT ACTIVITY:

1. Describe the start-up procedures in a dry run in a treatment plant.
2. Describe the shut-down procedures in a dry run in a treatment plant.
3. Perform the start-up procedures in a treatment plant.
4. Perform the shut-down procedures in a treatment plant.
5. Evaluate the operation of the effluent disposal unit to determine whether correct start-up procedures have been used. Use the normal operation procedures manual which the student has developed. (See objective 1.4.)
6. Evaluate the operation of the effluent disposal unit to determine whether correct shut-down procedures have been used. Use the normal operation procedures manual which the student has developed. (See objective 1.4.)

<<<<<<>>>>>>

OBJECTIVE 16.8: *Describe the abnormal operation procedures for the effluent disposal process.*

CONDITIONS: Given a wastestream in a treatment plant or color photographs of a wastestream, a checklist of the conditions of the wastestream and plant records and reference materials.

ACCEPTABLE PERFORMANCE: The student will:

Evaluate the wastestream for abnormal conditions, commenting on:

- acidity
- ammonia nitrogen
- BOD
- chloride
- chlorine demand
- chlorine residual
- COD
- coliforms
- color
- DO
- floating material
- flow
- foam
- grease
- grit
- ice
- nitrate nitrogen
- nitrite nitrogen
- odor
- oil
- organic and total Kjedahl nitrogen
- orthophosphate
- pH
- relative stability
- settleable matter
- sludge density
- suspended solids
- turbidity

Describe the cause and effect of the abnormal condition.

Explain how often the condition of the wastestream must be checked.

Describe what an operator does if he observes abnormal conditions, including:

- operational changes
- reporting to supervisors
- sampling procedures

Describe how the actions of the operator will improve the condition of the wastestream.

INSTRUCTOR ACTIVITY:

1. Describe and explain the abnormal conditions of the wastestream illustrated in color pictures.
2. Describe and explain the abnormal operation procedures illustrated in pictures and described in plant records and case histories.
3. Describe and explain the abnormal operation procedures during a slide show.

4. Describe and explain the abnormal operation procedures during a plant tour. Listen to the student's description of the procedures.

STUDENT ACTIVITY:

1. Evaluate and explain the abnormal conditions of the wastestream which are illustrated in color pictures.
2. Describe and explain the abnormal operation procedures illustrated in pictures and described in plant records and case histories.
3. Describe and explain the abnormal operation procedures in a class discussion after a slide show.
4. Evaluate and explain the condition of the wastestream during a plant tour. Describe and explain the abnormal operation procedures.

<<<<<>>>>>

OBJECTIVE 16.9: *Describe the preventive maintenance procedures for the effluent disposal unit.*

CONDITIONS: Given an effluent disposal unit or pictures and drawings of an effluent disposal unit and reference materials, including:

inspection records
manufacturer's maintenance guides
plant drawings and specifications
preventive maintenance schedule

ACCEPTABLE PERFORMANCE: The student will:

Describe these preventive maintenance procedures for the effluent disposal unit:

Cleaning
- channel
- filter
- flow-rate control mechanic
- motor
- piping
- pump

Lubrication
- bearing
- motor
- pump
- valve

Mechanical adjustment
- bearing
- coupling
- filter
- flow-rate control mechanic
- motor
- pressure control
- pump
- valve

Painting
- channel

Painting (continued)	fire-fighting equipment
motor	first-aid kit
piping	pipe
pump	valve
Replacement	Wear measurement
bearing	bearing
coupling	coupling

Name the reference materials and tools needed to perform the preventive maintenance procedures.

Explain how often each preventive maintenance procedure must be performed.

Explain how an operator determines whether a component needs preventive maintenance.

Describe what an operator does if a component needs preventive maintenance.

Explain why each preventive maintenance procedure is important.

INSTRUCTOR ACTIVITY:

1. Describe and explain the preventive maintenance procedures for the effluent disposal unit.
2. Describe and explain the preventive maintenance procedures during a slide show.
3. Describe and explain the preventive maintenance procedures during a plant tour.

STUDENT ACTIVITY:

1. Develop a preventive maintenance schedule and a manual of preventive maintenance procedures.
2. Observe, describe and explain the preventive maintenance procedures during a slide show.
3. Observe, describe and explain the preventive maintenance procedures during a plant tour.

<<<<<<>>>>>>

OBJECTIVE 16.10: *Perform the preventive maintenance procedures for the effluent disposal unit.*

CONDITIONS: Given an effluent disposal unit and tools and reference materials, including:

inspection records
manufacturer's maintenance guides
plant drawings and specifications
preventive maintenance schedule

ACCEPTABLE PERFORMANCE: The student will:

Select the reference materials and tools needed to perform the preventive maintenance procedures.

Apply the preventive maintenance schedule for the effluent disposal unit, explaining his actions.

Perform the procedures which an operator follows when a component needs preventive maintenance, explaining his actions.

INSTRUCTOR ACTIVITY:

1. Set up simulated situations in the workshop.
2. Observe student inspection of a treatment plant.
3. Observe the student performing the preventive maintenance procedures in a treatment plant.

STUDENT ACTIVITY:

1. Small groups of students perform the preventive maintenance procedures in simulated situations in the workshop.
2. Inspect a treatment plant. Evaluate and explain the preventive maintenance procedures.
3. Perform and explain the preventive maintenance procedures in a treatment plant.

<<<<<<>>>>>>

OBJECTIVE 16.11: *Describe the corrective maintenance procedures for the effluent disposal unit components listed on page 71.*

CONDITIONS: Given an effluent disposal unit or a mock-up, photographs or drawings of an effluent disposal unit, the manual of operation procedures which the student has developed for the effluent disposal unit, tools and reference materials, including:

catalogue of replacement parts
equipment catalogues
manufacturer's maintenance guides

ACCEPTABLE PERFORMANCE: The student will:

Describe how an operator evaluates each component of the effluent disposal unit for corrective maintenance, commenting on:

color
corrosion
flow
motion

odor
position
pressure
sound
temperature
vibration

Explain why a component has malfunctioned.

Name the reference materials and tools needed to perform the corrective maintenance.

Describe what an operator does when he discovers a malfunction, including:
- evaluation of capabilities of plant personnel to perform the procedures
- selection of replacement parts
- record keeping

Describe how the operator corrects the malfunction.

INSTRUCTOR ACTIVITY:

1. Describe and explain the corrective maintenance procedures for the effluent disposal unit, using diagrams and pictures.
2. Describe and explain the corrective maintenance procedures during a slide show.
3. Describe and explain the corrective maintenance procedures during treatment plant tours.

STUDENT ACTIVITY:

1. Describe and explain the corrective maintenance procedures in situations described or pictured by the instructor.
2. Describe and explain the corrective maintenance procedures during a slide show.
3. Observe, describe and explain the corrective maintenance procedures during a treatment plant tour.

<<<<<<<>>>>>>>

OBJECTIVE 16.12: *Perform the corrective maintenance procedures for the effluent disposal unit components.*

CONDITIONS: Given an effluent disposal unit or unit components, the operation procedures manual which the student has developed, tools and reference materials, including:
- catalogue of replacement parts
- equipment catalogues
- manufacturer's maintenance guides
- manufacturer's operation manual

ACCEPTABLE PERFORMANCE: The student will:

Evaluate the components of the effluent disposal unit for corrective maintenance, explaining why a component has malfunctioned and commenting on:

color	position
corrosion	pressure
flow	sound
motion	temperature
odor	vibration

Select the reference materials and tools needed to perform the corrective maintenance.

Perform the procedures which an operator follows when a component malfunctions, including:
- evaluation of capabilities of plant personnel to perform the procedures
- selection of replacement parts
- record keeping

Correct the malfunction.

INSTRUCTOR ACTIVITY:

1. Set up simulated situations in the workshop.
2. Observe the student as he evaluates the components in a treatment plant.
3. Observe the student performing the corrective maintenance procedures in a treatment plant.

STUDENT ACTIVITY:

1. Small groups of students perform and explain the corrective maintenance procedures in simulated situations in the workshop.
2. Evaluate the components for corrective maintenance.
3. Perform and explain the corrective maintenance procedures in a treatment plant.

<<<<<<>>>>>>

OBJECTIVE 16.13: *Perform the safety procedures for the effluent disposal unit and demonstrate how they protect employees and visitors.*

CONDITIONS: Given a list of operation or maintenance procedures, the student's manual of safety procedures, tools and safety equipment.

ACCEPTABLE PERFORMANCE: The student will:

Identify hazardous conditions in the effluent disposal unit, commenting on:
- high-risk activities
- sources of danger
- safety equipment

Explain how the procedures protect employees and visitors.

Recommend corrective procedures and correct the unsafe condition.

INSTRUCTOR ACTIVITY:

1. Set up simulated situations in the workshop.
2. Observe the student as he evaluates the safety conditions in a treatment plant.
3. Observe the student performing the safety procedures in a treatment plant.

STUDENT ACTIVITY:

1. Evaluate safety conditions in simulated situations and recommend corrective procedures.
2. Evaluate safety conditions in a treatment plant and recommend corrective procedures.
3. Perform the safety procedures in a treatment plant.

<<<<<<>>>>>>

OBJECTIVE 16.14: *Compare other effluent disposal units to the direct reuse system (composite model plant unit Q).*

CONDITIONS: Given a process unit and reference materials, including:
- equipment catalogues
- laboratory reports
- manufacturer's bulletins
- manufacturer's operation manuals
- plant maintenance and operation records

ACCEPTABLE PERFORMANCE: The student will:

Compare composite model plant unit Q with:
- an underground disposal system.
- a dilution system.
- an irrigation system.
- an intermittent sand filter unit as used in tertiary treatment.

Consider:
availability of replacement parts
capital costs
dependency on surrounding environment
ease of repair
efficiency
flow-handling capabilities
maintenance costs
nuisance to neighbors
operational costs
operational skills
personnel requirements
reliability
resistance to upset
sensitivity of controls
space requirements
waste-handling capabilities

INSTRUCTOR ACTIVITY:

1. Prepare a chart for tabulation of information about the units.
2. Compare composite model plant unit Q with the other units.
3. Help the student to collect information for reports on the advantages and disadvantages of each unit.

STUDENT ACTIVITY:

1. List information about the units on a chart.
2. Compare the units in a panel discussion.
3. Write a report on the advantages and disadvantages of each unit.

<<<<<<>>>>>>

OBJECTIVE 16.15:

Name and locate the components of the effluent disposal unit listed on page 71. Name and select reference materials which explain the normal operation procedures, the purpose of each component, how the component works and why it is important.

CONDITIONS:

Given an effluent disposal unit, unit components or a diagram, model or photographs of a unit and reference materials, including:
contractor's plans of the effluent disposal unit
manufacturer's maintenance guides
operation and maintenance manuals

ACCEPTABLE PERFORMANCE: The student will:

Name and locate the components of the effluent disposal unit.

Name and select reference materials which explain the normal operation procedures, the purpose of each component, how the component works and why it is important.

INSTRUCTOR ACTIVITY:

1. Point out components of the effluent disposal unit on diagrams, photographs or models.
2. Listen to the student naming the components and the applicable reference materials during a plant tour.
3. Name and display the reference materials which describe the effluent disposal unit and normal operation procedures.

STUDENT ACTIVITY:

1. Name the components which the instructor points out on diagrams, photographs or models.
2. Name the components which the instructor points out during a plant tour and name the reference materials which apply to the components.
3. Name and select the reference materials which describe the effluent disposal unit and normal operation procedures.

<<<<<<>>>>>>

OBJECTIVE 16.16: *Perform the abnormal operation procedures for the effluent disposal unit.*

CONDITIONS: Given a wastestream in a treatment plant and reference materials, including:

industrial waste records
operation logs
operator manuals
plant performance guides

ACCEPTABLE PERFORMANCE: The student will:

Evaluate the wastestream for abnormal conditions, commenting on:

acidity	BOD
ammonia nitrogen	chloride

chlorine demand	nitrite nitrogen
chlorine residual	odor
COD	oil
coliforms	organic and total Kjedahl nitrogen
color	orthophosphate
DO	pH
floating material	relative stability
flow	settleable matter
foam	sludge density
grease	suspended solids
grit	turbidity
ice	
nitrate nitrogen	

Select the references he needs to return the wastestream to normal.

Perform the abnormal operation procedures.

INSTRUCTOR ACTIVITY:

1. Observe the student as he evaluates the wastestream in a treatment plant.
2. Describe the references needed to correct abnormal conditions of the wastestream.
3. Observe the student performing the abnormal operation procedures in simulated situations and in a treatment plant.

STUDENT ACTIVITY:

1. Evaluate the wastestream in a treatment plant.
2. Select the references needed to correct abnormal conditions of the wastestream.
3. Perform the abnormal operation procedures in simulated situations or in a treatment plant.

<<<<<<>>>>>>